REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

DATA EVALUATION SUMMARY REPORT

Remedial Investigation/Feasibility Study
OMC Plant 2 Site
Waukegan, Illinois
WA No. 018-RICO-0528/Contract No. EP-S5-06-01

March 2008

PREPARED FOR

U.S. Environmental Protection Agency

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Acronyms and Abbreviations

µg/L	micrograms per liter
bgs	below ground surface
CLP	Contract Laboratory Program
cm/sec	centimeters per second
CSU	Colorado State University
CVOC	chlorinated volatile organic compound
DCE	dichloroethene
DNAPL	dense nonaqueous phase liquid
DO	dissolved oxygen
DPT	direct-push technology
ECD	electron capture device
EISB	enhanced in situ bioremediation
EOS™	emulsified oil substrate
FS	feasibility study
ft^2	square foot
ft/ft	foot per foot
g/kg	grams per kilogram
IEPA	Illinois Environmental Protection Agency
LNAPL	light nonaqueous phase liquid
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MIP	membrane interface probe
MNA	monitored natural attenuation
mV	millivolt
NAPL	nonaqueous phase liquid
O&M	operation and maintenance
OMC	Outboard Marine Corporation

ORP	oxidation-reduction potential
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
Rf	retardation factor
RI	remedial investigation
TCE	trichloroethene
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
ZVI	zero-valent iron

SECTION 1

Introduction

This data evaluation summary report presents the results of the site-wide groundwater sampling events conducted as part of the pilot test activities associated with the remedial investigation (RI)/feasibility study (FS) at the Outboard Marine Corporation (OMC) Plant 2 site in Waukegan, Illinois. The work was performed for the U.S. Environmental Protection Agency (USEPA) in accordance with the statement of work for Work Assignment No. 018-RICO-0528.

This data evaluation summary report contains the following components:

- Section 1 provides a general description of the site background and an overview of the pilot test activities and objectives.
- Section 2 describes the supporting pilot test activities including the investigation of dense nonaqueous phase liquids (DNAPL), the installation of monitoring and injection wells, baseline groundwater sampling, annual site-wide groundwater sampling and bench-scale testing, and updates to the physical and chemical conceptual site model based on the investigation results.
- Section 3 presents an evaluation of natural attenuation.
- Section 4 presents the methodology and findings of the fate and transport modeling.
- Section 5 provides the references cited in this document.
- Appendix A contains the technical memorandums that describe the individual field activities.
- Appendix B contains the data usability evaluations and provides the analytical data summary tables.
- Appendix C contains a Colorado State University (CSU) report summarizing the bench-scale evaluation of zero-valent iron (ZVI).
- Appendix D contains examples of the BIOCHLOR modeling files.

1.1 Project Background

This section provides a brief summary of the project background. Detailed discussions of the site history and physical and chemical characteristics are presented in the RI report (CH2M HILL, 2006b) and the FS report (CH2M HILL 2006a).

The OMC Plant 2 site is at 100 East Seahorse Drive, Waukegan, Illinois and is the fourth operable unit (OU) of the OMC National Priorities List (NPL) site. The 65-acre site included a 1,036,000-square foot (ft^2) former manufacturing plant building (that is, Plant 2) and several parking lot areas to the north and south of the building complex (Figure 1-1). In

2006, the City of Waukegan demolished a portion of the plant building (approximately 400,000 ft^2). The site includes two polychlorinated biphenyl (PCB) containment cells in which PCB-contaminated sediment (dredged from the Waukegan Harbor in the early 1990s) and PCB-impacted soil are managed. The cells (the "East Containment Cell" and "West Containment Cell") are located north of Plant 2. OMC performed the harbor dredging work under a 1988 consent decree with USEPA and the Illinois Environmental Protection Agency (IEPA) that also required long-term operations and maintenance (O&M) of the containment cells.

OMC designed, manufactured, and sold outboard marine engines, parts, and accessories to a worldwide market for many years. Plant 2 was a main manufacturing facility for OMC—the major production lines used PCB-containing hydraulic and lubricating/cutting oils, chlorinated solvent-containing degreasing equipment, and smaller amounts of hydrofluoric acid, mercury, chromic acid, and other similar chemical compounds.

OMC filed for bankruptcy protection on December 22, 2000, and later abandoned the property after completing a limited removal action under USEPA oversight. In November 2001, the bankruptcy trustee filed a motion to abandon OMC Plant 2. USEPA conducted a site discovery inspection in spring 2002 to document the presence of numerous chemical compounds in OMC Plant 2 and support the allegation of imminent and substantial endangerment. Based on the findings, USEPA and the State of Illinois filed a joint objection to the abandonment and alleged that the site posed an imminent and substantial endangerment to public health and welfare and the environment. The bankruptcy trustee negotiated an emergency removal action scope of work with USEPA and IEPA that the court approved on July 17, 2002. The waste removal activities for the OMC Trust were completed in November 2002 and the Trust abandoned the OMC Plant 2 property on December 10, 2002.

USEPA assumed control of building security and utilities on December 10, 2002, and planned further removal actions to clean up more of OMC Plant 2 in spring 2003. USEPA maintained electrical power to support O&M of the PCB containment cells until December 10, 2003, after which time, the State took over O&M of the cells.

The RI field investigation was conducted between January and June 2005 and identified the following potential environmental problems (CH2M HILL, 2006b):

- PCB-contaminated concrete floors, walls, and ceilings exist in the old die cast, parts storage, and metal working areas.
- Soil beneath the northern and southern parking lot areas and east of the plant contain PCBs and/or polynuclear aromatic hydrocarbons (PAHs) at levels that exceed their respective preliminary cleanup goals.
- Chlorinated solvents in substantial quantities, including a trichloroethene (TCE) DNAPL pool, exist beneath the site.
- A chlorinated solvent groundwater plume potentially is migrating into Lake Michigan.

Based on the data collected, potential alternatives were developed and evaluated in the FS report to address the contaminated building materials, soil and sediment, and groundwater and DNAPL (CH2M HILL, 2006a). In December 2006, USEPA issued a proposed plan for the cleanup of contaminated building materials, soil, and sediment and indicated that the remedy for groundwater and DNAPL would be identified after an evaluation of possible cleanup methods is completed.

1.2 Overview of the Pilot Test Activities

The FS report identified two in situ treatment technologies (chemical reduction in the DNAPL source zones and enhanced in situ bioremediation (EISB) in the groundwater source zones) as viable response actions to address the source zones and the resulting groundwater plume of chlorinated volatile organic compounds (CVOCs). A pilot test was developed to determine whether the in situ technologies could be used as a major component of the groundwater remedy and how the selected in situ technology would be implemented full scale at the site.

The pilot test activities are being implemented in accordance with the USEPA-approved *Supplemental Field Sampling Plan* (CH2M HILL, 2006c) and the *Supplemental Quality Assurance Project Plan* (CH2M HILL, 2007). Additional information on the development of the pilot test approach including possible treatment areas, types of amendments, and costs are presented in the *OMC Plant 2 (OU#4) Groundwater Treatment Pilot Study* memorandum (CH2M HILL, 2006). The actual implementation and results of the in situ treatment activities are presented in the separate *Enhanced In Situ Bioremediation Pilot Study Report* (CH2M HILL, 2008).

1.2.1 Treatment Areas

Source Zones

The results of the RI indicate that the groundwater contamination is related to the use of chlorinated solvents, primarily TCE, in past manufacturing operations at OMC Plant 2. Data indicate that the chlorinated “parent compound” in groundwater (TCE) was released to the subsurface during manufacturing operations and created “source zones.” Source zones are defined as portions of the aquifer that have particularly high dissolved phase TCE concentrations, and which may have residual DNAPL or high concentrations of adsorbed TCE that can continue to create and sustain dissolved phase plumes.

Based on the findings of the membrane interface probe (MIP), soil, and groundwater investigations and the conceptual site model, five source zones were identified in the *Feasibility Study Report* (CH2M HILL, 2006a). Two of the five source zones, Areas 4 and 5, are being targeted by the in situ treatment pilot test in an attempt to reduce the mass of TCE and contributions to the downgradient groundwater plume (Figure 1-1).

DNAPL Area

While in situ biodegradation methods have been found to be effective for reducing dissolved phase contamination, they have not yet been shown to be highly effective for directly remediating nonaqueous phase liquid (NAPL). The presence of DNAPL outside the building in the eastern portion of Area 2 requires more active remedial alternatives than enhancing bioremediation. In situ soil mixing using a chemical reducing agent was selected to target the DNAPL area. The results of testing the soil mixing technology will determine if soil mixing would provide effective treatment of the DNAPL and whether it should be implemented if other DNAPL areas are found during building demolition or subsequent site remediation.

1.2.2 Source Zone and Groundwater Plume Activities

Based on the selected treatment areas and the potential in situ remedial technologies identified for the source zones and groundwater plume, the overall objectives for the source zone pilot test are as follows:

1. Evaluate the degree to which in situ treatment through substrate injection can reduce the concentrations of TCE and degradation products (cis-1,2-dichloroethene [cis-1,2-DCE] and vinyl chloride) in the target treatment source zones and downgradient monitoring locations.
2. Determine the overall effectiveness of in situ treatment for achieving complete reduction of TCE to nontoxic degradation products (such as ethene or ethane).
3. Monitor the duration that the injected substrates can maintain enhanced, relative to background, reducing conditions for in situ treatment.
4. Determine the radius of influence of the selected injection method.

An additional objective of the pilot test is to examine the effectiveness of two different amendments—a soluble substrate (such as sodium lactate) and an edible oil substrate (EOS™). Both amendments work to enhance the natural reductive dechlorination processes in the aquifer. The composition and historical performance for both amendments indicate that either could be effectively used in the enhanced in situ bioremediation (EISB) remedial alternative. The testing will help to determine which amendment is more effective, under actual site conditions, in treating the site-related CVOCs and should be recommended for use during the final remedy implementation.

The EISB pilot test consisted of the following activities:

1. Injection well and monitoring well installation (including baseline groundwater sampling and analysis)
2. Injection of amendment
3. Post-injection performance monitoring (secondary and primary)
4. Follow-up injections, as needed

The description and results of the amendment injections and the post-injection monitoring are presented in a separate *Enhanced In Situ Bioremediation Pilot Study Report* (CH2M HILL, 2008).

1.2.3 DNAPL Activities

The objective of pilot testing related to DNAPL is to evaluate the reduction of the mass of DNAPL and mass flux of dissolved phase contamination from remaining DNAPL achieved through shallow soil mixing of ZVI and bentonite. Preliminary data collection activities conducted to design the soil mixing pilot test included the following:

- Conducting a limited investigation to define the extent and thickness of the DNAPL area.
- Installing monitoring wells to establish existing groundwater conditions and monitor changes resulting from the soil mixing.
- Performing a bench-scale test to evaluate the optimum dosage and source for the ZVI, potential amendments to control hydrogen gas production, and enhance post-mixing soil strength. CSU performed the bench-scale testing, the patent holder for this technology.

SECTION 2

Investigation Results

This section describes the preliminary activities for the EISB and the design of the soil mixing pilot tests and discusses updates for the physical and chemical site models presented in the RI report.

2.1 Source Zone and Plume Investigation

2.1.1 Investigation

Field activities in support of the EISB pilot testing were conducted in January through March 2007 and in September 2007 and included installing and developing monitoring wells and permanent injection wells, measuring groundwater levels, and collecting groundwater samples. Groundwater samples were collected from new and existing monitoring well locations in February 2007 and September 2007 to evaluate groundwater quality conditions. The new monitoring well locations were based on potential source zones where the amendment injections were to be performed and observations during fieldwork. The following describes the name, location, and rationale for installing the monitoring wells:

- Seven monitoring wells (MW-523S/D, MW-524S, MW-525S/D, and MW-526S/D) were installed in the northern courtyard between the metal working area and the former new die cast area (Source Zone 2) to provide groundwater quality data downgradient of the TCE DNAPL area.
- Six monitoring wells (MW-527S/D, MW-528S/D, and MW-529S/D) were installed in Source Zone 4, near the corporate building to evaluate the effectiveness of the EISB pilot test using sodium lactate.
- Ten monitoring wells (MW-518S/D, MW-519S/D, MW-520S/D, MW-521S/D, and MW-522S/D) were installed within the Plant 2 building, in and around Source Zone 5, to evaluate the effectiveness of the EISB pilot test using EOS™.
- Two monitoring wells (MW-530S/D) were installed south of the former hazardous waste storage building downgradient of the monitoring well (MW-517D) where PCB DNAPL was encountered to evaluate if dissolved PCBs are migrating to Waukegan Harbor.

New and existing monitoring well locations are presented on Figure 2-1. A description of the locations and procedures are summarized in the hydrogeologic investigation technical memorandum provided in Appendix A.

Upon completing the monitoring well development, a site-wide groundwater sampling event was performed in February 2007 to characterize the baseline conditions before initiating the pilot test. A subsequent “annual” site-wide sampling event was conducted in September 2007 to evaluate temporal changes in groundwater quality. The groundwater samples were collected using low-flow methods from all newly installed monitoring wells and intact existing monitoring wells. The sampling was conducted in accordance with procedures presented in the USEPA publication, *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (2002a). The groundwater samples were analyzed for volatile organic compounds (VOCs), including CVOCs, and natural attenuation parameters. Selected samples also were analyzed for PCBs. A description of the groundwater sampling procedures is provided in the hydrogeologic investigation technical memorandums in Appendix A.

The groundwater samples for VOCs and PCBs were submitted to a laboratory in the USEPA's Contract Laboratory Program (CLP), and USEPA validated the analytical data. CT Laboratories in Baraboo, Wisconsin, analyzed the natural attenuation parameters including dissolved gasses, dissolved metals, anions, alkalinity, sulfide, total organic carbon (TOC), and volatile fatty acids. Appendix B contains the evaluations on the usability of the analytical data.

2.1.2 Physical Conditions

Stratigraphy

The subsurface materials encountered during the field activities were consistent with the stratigraphic data presented in the *Remedial Investigation Report* (CH2M HILL, 2006b). The subsurface materials encountered include near-surface fill materials above a naturally occurring sand unit that overlies clay till. The fill materials extend to between 2 and 12 feet below ground surface (bgs). A poorly graded sand or silty sand deposit underlie the fill materials, to depths between 25 and 30 feet. A hard gray clay that forms the lower boundary of the unconfined aquifer lies beneath the sand unit. Representative stratigraphic sections are presented in the *Remedial Investigation Report* (CH2M HILL, 2006b).

Hydrogeology

Baseline Conditions (February 2007)

Groundwater is shallow and was encountered at depths ranging between 1 and 7 feet, depending on the ground surface elevation. This depth appears to be heavily influenced by freezing and snowmelt. During site-wide gauging in February 2007, groundwater was found to be frozen inside a number of wells, typically in those screened in the shallow aquifer. During the latter part of the investigation, water in MW-530S/D located in the southwestern corner of the site exhibited artesian conditions after significant snowmelt had occurred.

The potentiometric surface maps for the shallow and deep portions of the aquifer are presented on Figures 2-2 and 2-3, respectively. The horizontal groundwater flow direction in the shallow portion of the aquifer is from west to east across the northern portion of the site (toward Lake Michigan) under an average horizontal groundwater gradient of 0.0005 foot per foot (ft/ft). Shallow groundwater flow direction in the southern portion of the site is toward the south (Waukegan Harbor) with an average horizontal gradient of 0.002 ft/ft. Based on the average porosity and the average hydraulic conductivity value (30 percent and 2.2×10^{-2} centimeters per second [cm/sec], respectively), the average linear groundwater velocity for the shallow zone is estimated to range from 40 to 150 feet per year.

The groundwater elevation map for the deeper portion of the aquifer indicates a flow direction pattern similar to the upper zone. The horizontal groundwater flow direction in the deep portion of the aquifer is from west to east across the northern portion of the site (toward Lake Michigan) under an average horizontal groundwater gradient of 0.0006 ft/ft. Deep groundwater flow direction in the southern portion of the site is toward the south (Waukegan Harbor) with an average horizontal gradient of 0.002 ft/ft. The average linear groundwater flow velocities, using an average porosity of 30 percent, range from approximately 10 to 40 feet per year across the site in the deeper zone.

Vertical gradients between the shallow and deep portions of the aquifer are almost nonexistent in most places, ranging from a measured 0.02 ft/ft in the downward direction to -0.06 ft/ft in the upward direction. Fifteen of the 31 well nests, however, register either no difference in groundwater elevation between shallow and deep wells, or a negligible difference of 0.001 ft/ft. This information confirms that the shallow and deep well locations are essentially monitoring the same aquifer.

September 2007 Conditions

The potentiometric surface maps for the shallow and deep portions of the aquifer based on the September 2007 measurements are presented on Figures 2-4 and 2-5, respectively. Consistent with the February data, the groundwater elevation map for the shallow and deeper portions of the aquifer exhibit similar flow direction patterns. Groundwater levels across the site in September 2007 were about 0.6 to 2.1 feet higher in the shallow zone and 0.3 to 1.3 feet higher in the deeper zone than observed in February. In general, the monitoring wells with the greatest difference (greater than 1.1 feet) were in the southeastern portion of the site near the New Die Cast Area and the South Ditch. The wells along the North Ditch generally exhibited the least amount of change between February and September. As a result, the flow pattern for both the shallow and deeper groundwater indicated a more pronounced flow path toward the North Ditch than previously observed. The horizontal gradients in the shallower and deeper portions toward the east (Lake Michigan) were slightly lower than calculated in February and toward the south (Waukegan Harbor) were slightly higher than calculated in February.

Vertical gradients between the shallow and deep portions of the aquifer were nominal in most places, ranging from a measured 0.18 ft/ft in the downward direction to -0.003 ft/ft in the upward direction. Fourteen of the 31 well nests, however, register either no difference in groundwater elevation between shallow and deep wells, or a negligible difference of 0.001 ft/ft. This information confirms that the shallow and deep well locations are essentially monitoring the same aquifer.

2.1.3 Baseline Groundwater Quality Conditions

Similar to previous investigations conducted by OMC and USEPA, the hydrogeologic investigation focused on two zones within the aquifer. The shallow groundwater zone includes the water table surface and includes 34 wells installed up to 15 feet deep. The deep groundwater zone is monitored by 44 wells that are installed above the till surface at depths up to approximately 30 feet. Investigation results are discussed below using reference to shallow and deep groundwater zones. Analytical results for VOCs, PCBs, and metals are presented on Tables 2-2 through 2-4, respectively.

Volatile Organic Compounds

CVOCs were the most frequent VOC found at concentrations exceeding groundwater remediation objectives presented in Table 2-1. Benzene was detected at 10 locations at concentrations exceeding groundwater remediation objectives. TCE, cis-1,2-DCE, and vinyl chloride concentrations are shown on Figures 2-6 through 2-11 for shallow and deep groundwater zones. A summary of VOC concentrations is provided on Table 2-2.

Trichloroethene

TCE was detected in shallow groundwater ranging from 1 to 2,300 micrograms per liter (µg/L), exceeding the groundwater screening level of 0.03 µg/L at 19 locations. The overall distribution of TCE in the shallow zone is consistent with the findings of the RI; however, the elevated concentrations of TCE in the eastern portion of the building were not detected during this investigation (Figure 2-6).

TCE was detected in deep groundwater ranging from 0.12 to 210,000 µg/L, exceeding the groundwater screening level at 16 locations. The distribution and magnitude of the highest TCE detections are in Source Zones 2 and 5, and to a lesser degree in Source Zone 4 (Figure 2-7). The elevated TCE concentrations detected in MW-523D (210,000 µg/L) and MW-525D (78,000 µg/L) are located in Source Zone 2 where free-phase TCE was observed during the DNAPL investigation. The impacted area of Source Zone 2 extends further south than indicated by the RI data. The additional monitoring wells in Area 5 also result in a better delineation of the TCE distribution for this area. The elevated TCE concentrations observed in deep groundwater in Source Zone 5 were in Monitoring Wells MW-505D (17,000 µg/L), MW-520D (23,000 µg/L), and MW-522D (44,000 µg/L) The area expanded from the original groundwater grab sample collected at SO-049 to include MW-505D, MW-520D, MW-521D, and MW-522D. The concentrations also were found to be an order of magnitude higher than the samples collected during the RI. Concentrations in Source Zone 4 are an order of magnitude lower than that detected during the RI. TCE impacts offsite to the south are likely negligible. No additional impacted areas were discovered during this investigation.

The distribution of TCE detected in the deep groundwater is similar to that found in the shallow groundwater in Source Zones 2 and 4. TCE was detected in the shallow zone groundwater in Source Zone 5 at lower concentrations and to a lesser extent than in other source zones. Comparison of the magnitude of the concentrations between the samples from the shallow and deep wells indicates the TCE concentrations generally increase with depth in Source Zones 2 and 5, but decrease with depth in Source Zone 4.

Cis-1,2-Dichloroethene

Cis-1,2-DCE was detected in shallow groundwater ranging from 0.33 to 3,900 µg/L, exceeding the groundwater screening level of 61 µg/L at 11 locations (Table 2-2). The distribution and magnitude of cis-1,2-DCE observed in the shallow zone is consistent with RI findings with the exception that a light nonaqueous phase liquid (LNAPL) containing cis-1,2-DCE was observed in MW-503S. Cis-1,2-DCE concentrations in the shallow zone are illustrated on Figure 2-8.

Cis-1,2-DCE was detected in deep groundwater ranging from 0.22 to 240,000 µg/L, exceeding the groundwater screening level at 20 locations.

The distribution and magnitude of the highest cis-1,2-DCE detections are primarily east of and within Source Zone 5, and to a lesser degree in Source Zones 2 and 4 (Figure 2-9). Similar to TCE, the distribution of cis-1,2-DCE in Source Zone 5 extends further west than anticipated from the RI data (CH2M HILL, 2006b). The Source Zone 5 concentrations were also significantly higher in MW-506D (an order of magnitude higher) and MW-505D (two orders of magnitude higher) than previously detected. The elevated cis-1,2-DCE concentrations detected in the deep zone at MW-506D (240,000 µg/L) and MW-503D (170,000 µg/L) are located east of Source Zone 5 near the former chip wringer, where the LNAPL was encountered in MW-503S. The additional areas of elevated cis-1,2-DCE were observed in deep groundwater in Source Zone 2 at MW-523D (70,000 µg/L) and MW-525D (5,000 µg/L), and to a lesser degree in Source Zone 4 where the maximum concentration was 2,600 µg/L at MW-514S in the shallow zone groundwater and 2,300 µg/L at MW-514D in the deep zone groundwater. The groundwater sample from the deep Monitoring Well W-6, located at the southwest corner of the East Containment Cell area, also contained cis-1,2-DCE at a concentration of 3,400 µg/L. The concentrations at this well are consistent with what was presented in the RI (CH2M HILL, 2006b); however, concentrations are not likely related to impacts observed in the main source zones. No additional impacted areas were discovered during this investigation.

The distribution of cis-1,2-DCE detected in the deep groundwater is similar to that identified in the shallow zone in Source Zones 2 and 4. Concentrations of cis-1,2-DCE observed in the shallow zone in Source Zone 5 were negligible. Comparison of the magnitude of the concentrations between the samples from the shallow and deep wells indicates that the cis-1,2-DCE concentrations generally increase with depth in Source Zones 2 and 5, but slightly decrease with depth in Source Zone 4.

Vinyl Chloride

Vinyl chloride was detected in shallow groundwater ranging from 0.11 to 1,800 µg/L, exceeding the screening level of 0.02 µg/L at 24 locations. Vinyl chloride was detected in deep groundwater ranging from 0.13 to 30,000 µg/L, exceeding the screening level at 33 locations (Table 2-2). The distribution and magnitude of the highest vinyl chloride detections are in Source Zones 4 and 5, and to a much lesser degree in Source Zone 2 (Figure 2-10). The highest concentration of vinyl chloride was detected in MW-506D (30,000 µg/L) in Source Zone 5. The additional areas of elevated vinyl chloride were observed in deep groundwater in Source Zone 4 at MW-512D (5,000 µg/L), MW-154D (1,700 µg/L), and MW-529D (1,500 µg/L) and to a much lesser degree in Source Zone 2 where concentrations ranged from 130 to 790 µg/L in the deep groundwater. Monitoring Well W-6, located at the southwest corner of the East Containment Cell area, also exhibited a vinyl chloride concentration of 1,000 µg/L.

The distribution of the vinyl chloride detected in the deep groundwater is similar to that identified in the shallow groundwater (Figure 2-11). Comparison of the magnitude of the concentrations between the samples from the shallow and deep wells indicates that the vinyl chloride concentrations generally increase with depth. No additional impacted areas were discovered during this investigation.

Polychlorinated Biphenyl Dense Nonaqueous Phase Liquid

During groundwater gauging activities, approximately 6 to 8 inches of DNAPL was encountered in Monitoring Well MW-517D adjacent to the former hazardous waste storage building. The product was dark brown/black in color, highly viscous, and had minimal odor. DNAPL had not been observed at this location during the sampling in 2005. A sample of the NAPL was collected with a bailer and sent to CT Laboratories for characterization. Results indicated that the DNAPL contains 1,100,000 milligrams per kilogram (mg/kg) of Aroclor 1248. The 2005 groundwater data were reviewed and 61 µg/L of Aroclor 1248 and 110 µg/L of Aroclor 1232 were reported in samples from the shallow (MW-517S) and deep (MW-517D) wells at this location, respectively.

In response to the presence of the PCB DNAPL, an additional well nest (MW-530S/D) was installed downgradient of MW-517D. A small-scale groundwater sampling event was conducted in March 2007 to delineate the extent of dissolved-phase PCBs in the area. The sampling included the shallow well MW-517S, upgradient monitoring wells (MW-510S and MW-510D), and downgradient wells (MW-513S, MW-513D, MW-530S, MW-530D, W-2, and W-3). PCBs only were detected in the groundwater sample from the shallow well above the DNAPL (MW-517S) at estimated concentrations of 100 and 9.3 µg/L for Aroclors 1248 and 1260, respectively.

Light Nonaqueous Phase Liquid

The chip wringer is located on the north side of the building, in the western portion of the metal working area. In addition to the chip wringer, a 4,000-gallon TCE underground storage tank (UST) was reportedly located in this area of the plant. During the MIP investigation conducted in 2005, elevated photoionization detector (PID) and electron capture detector (ECD) readings were recorded, indicating the presence of residual CVOC contamination. Soil and groundwater samples in the vicinity of MW-503S collected in 2005 did not contain compounds or concentrations indicative of LNAPL.

During the baseline groundwater sampling, LNAPL was encountered in the monitoring well (MW-503S) near the chip wringer. The product was approximately 2 to 3 inches thick, brown, viscous, and had an odor. A sample of the LNAPL was collected and sent to CT Laboratories for characterization. The concentrations detected in the February sample were not as high as would be expected for an LNAPL. Therefore, an additional LNAPL sample was collected for re-characterization during the annual sampling event. The LNAPL samples were of similar composition and magnitude as the baseline sample and were comprised of the following:

Analyte	Concentration (mg/kg) 02/01/2007	Concentration (mg/kg) 09/01/2007
Aroclor-1248	810	580
Trichloroethene	4.4	6.6
trans-1,2-Dichloroethene	7.8	15
Chloroform	ND	14
m & p-Xylene	9.8	9
Tetrachloroethlyene	ND	8.2
o-Xylene	11	11
Ethylbenzene	12	14
1,1-Dichloroethene	14	19

Analyte	Concentration (mg/kg) 02/01/2007	Concentration (mg/kg) 09/01/2007
Toluene	17	20
1,1-Dichloroethane	22	47
Methylene chloride	44	ND
Vinyl chloride	120	520
1,1,1-Trichloroethane	610	800
cis-1,2-Dichloroethene	830	1600

2.1.4 September 2007 Groundwater Quality Conditions

The results of the annual groundwater sampling event conducted in September 2007 are discussed below. Analytical results for VOCs, PCBs, and metals are presented in Tables 2-5 through 2-7, respectively.

Volatile Organic Compounds

TCE, cis-1,2-DCE, and vinyl chloride were the most frequently detected VOCs found at concentrations exceeding groundwater remediation objectives presented in Table 2-1. Other constituents found to exceed groundwater screening levels include 1,1-dichloroethlyene, 1,4-dichlorobenzene, benzene, chloroethane, dichloromethane, and trans-1,2-dichloroethlyene. TCE, cis-1,2-DCE, and vinyl chloride concentrations are shown on Figures 2-12 through 2-17 for shallow and deep groundwater zones. A summary of detected VOC concentrations is provided in Table 2-5.

Trichloroethene

TCE was detected in shallow groundwater ranging from 0.98 to 1,900 µg/L, exceeding the groundwater screening level of 0.03 µg/L at 16 locations (Figure 2-12). Concentrations of TCE detected in the shallow groundwater are slightly lower in magnitude and distribution in Source Zones 2 and 4 than found during the baseline sampling. However, TCE was found to be an order of magnitude higher in MW-511S during the annual sampling event. TCE concentrations in Source Zone 5 remained stable and are negligible.

TCE was detected in deep groundwater ranging from 150 to 150,000 µg/L, exceeding the groundwater screening level at 7 locations. The highest TCE detections are in Source Zones 2 and 5, and to a lesser degree in Source Zone 4 (Figure 2-13). The elevated TCE concentrations detected in Source Zone 2 are lower than the baseline sample results. In Source Zone 4, MW-529D and MW-514D had concentrations exceeding the screening level during baseline sampling, however, were not detected during this event; TCE was detected only at MW-528D. TCE concentrations offsite to the south are minimal. Concentrations are similar in magnitude and distribution to baseline conditions, with the exception of MW-522D (100,000 µg/L) in Source Zone 5, which was found to be significantly higher than the baseline results. The elevated TCE concentrations detected in Source Zone 5 were found to be higher than the baseline sample results. No additional impacted areas were discovered during this sampling event.

The magnitude of September 2007 TCE concentrations in groundwater from the shallow and deep monitoring wells are generally comparable to or less than observed baseline concentrations (February 2007), with the exception of MW-522D and MW-511S which are appreciably higher. The distribution of concentrations is generally the same as observed during the baseline. In comparison to concentrations found in the shallow and deep wells, TCE concentrations generally increase with depth in Source Zones 2 and 5, but decrease with depth in Source Zone 4.

Cis-1,2-Dichloroethene

Cis-1,2-DCE was detected in shallow groundwater ranging from 0.32 to 3,700 µg/L, exceeding the groundwater screening level of 61 µg/L at 27 locations. The elevated cis-1,2-DCE concentrations detected in the shallow zone were found primarily in Source Zones 2 and 4, and to a lesser degree in Source Zone 5 (Figure 2-14). Cis-1,2-DCE concentrations in Source Zone 2 remained stable or decreased. Concentrations of cis-1,2-DCE detected in the shallow groundwater in Source Zone 4 were also generally consistent with the baseline sampling. Based on wells MW-522S and MW-520S, the cis-1,2-DCE concentrations in Source Zone 5 increased slightly from the baseline concentrations (MW-522S increased from 58 to 120 µg/L and MW-520S increased from 8.8 to 93 µg/L).

Cis-1,2-DCE was detected in deep groundwater ranging from 0.3 to 120,000 µg/L, exceeding the groundwater screening level at 20 locations (Figure 2-15). The distribution of cis-1,2-DCE in the deep groundwater is similar to that found during baseline sampling. Cis-1,2-DCE concentrations in Source Zone 2 showed insignificant changes relative to the baseline conditions. Concentrations of cis-1,2-DCE detected in the deep groundwater in Source Zone 4 were also generally consistent with baseline concentrations. The exception is MW-512D which was three orders of magnitude higher in September 2007 (120,000 µg/L) than during the baseline sampling in February 2007 (910 µg/L). Cis-1,2-DCE concentrations in Source Zone 5 decreased or significantly decreased (decreases of 5,900 to 120,000 µg/L), except at MW-522D. Cis-1,2-DCE concentrations in MW-522 increased from 9,300 to 25,000 µg/L. The cis-1,2-DCE concentrations also increased compared to the baseline concentrations downgradient of the East Containment Cell area (W-6 and MW-500D); however, concentrations are not likely related to impacts observed in the main source zones. No additional impacted areas were discovered during this sampling event.

The distribution of concentrations is generally consistent as observed during the baseline sampling event. In comparison to concentrations found in the shallow and deep wells, cis-1,2-DCE concentrations generally increase with depth in Source Zones 2, 4, and 5.

Vinyl Chloride

Vinyl chloride was detected in shallow groundwater ranging from 0.62 to 3,300 µg/L, exceeding the screening level of 0.02 µg/L at 23 locations (Figure 2-16). Vinyl chloride concentrations in Source Zone 2 exhibited no significant change. The highest concentrations of vinyl chloride in shallow groundwater were detected in MW-514S (3,300 µg/L) and MW-529S (2,200 µg/L) in Source Zone 4. Concentrations of vinyl chloride detected in the shallow groundwater are increasing in magnitude in Source Zones 4 and 5 compared to that found during the baseline sampling.

Vinyl chloride was detected in deep groundwater ranging from 0.69 to 21,000 µg/L, exceeding the screening level at 32 locations (Figure 2-17). The distribution of vinyl chloride detected in Source Zone 2 in the deep groundwater is similar in magnitude and distribution to that found in the deep groundwater during the baseline sampling, with some minor fluctuations. Concentrations in Source Zone 4 are generally increasing with the exception of MW-527D which is decreasing. Vinyl chloride was found to be significantly increasing east of Source Zone 5 as evidenced by concentrations in MW-503D (110,000 µg/L, about two orders of magnitude higher) and in MW-518D (15,000 µg/L, about one order of magnitude higher). Vinyl chloride concentrations within Source Zone 5 decreased compared with the baseline results. Monitoring Well W-6, located at the southwest corner of the East Containment Cell area, contained vinyl chloride at a concentration of 2,000 µg/L.

The highest vinyl chloride detections are in Source Zones 4 and 5, and to a much lesser degree in Source Zone 2. The distribution of concentrations is generally consistent with the baseline condition. In comparison to concentrations found in the shallow and deep wells, vinyl chloride concentrations increase with depth in Source Zones 2, 4, and 5. No additional impacted areas were discovered during this sampling event.

2.2 TCE DNAPL Investigation

A limited subsurface investigation was conducted in November and December 2006 using direct-push technology (DPT) methods (such as Geoprobe®) to delineate the extent of DNAPL area in the courtyard north of the trim building and east of the metal working area. The focused investigation included advancing 48 boring locations to the base of the aquifer (Figure 2-18). Thirty of the borings were installed in the western portion of the courtyard area (SO-200 through SO-229), and 18 borings were located in the northeast portion of the former paint room (SO-230 through SO-247). A discreet groundwater sample also was collected from boring locations SO-200 through SO-203 to evaluate for the presence of mobile and/or residual DNAPL. An amber-colored DNAPL with an oily appearance was observed in the groundwater grab sample collected from SO-203. Based on the borings, the dimensions of the DNAPL source zone are approximately 150 feet in the north-south direction and between 15 and 70 feet wide in an east-west direction. Because the DNAPL area extends further beneath the building than anticipated, the southwestern extent has not been fully defined. Additional information regarding the locations and procedures are summarized in the DNAPL investigation technical memorandum provided in Appendix A.

The investigation also provided additional data on the till surface topography as it relates to potential DNAPL movement. The variability in till surface elevation significantly impacts the locations where DNAPL is present (Figure 2-18). The data suggest that the DNAPL is primarily located within the topographically low spots of the till surface.

2.3 Bench-Scale Test

In conjunction with the DNAPL investigation, CSU conducted a bench-scale test to support the evaluation of ZVI-clay in situ soil mixing technology for soil remediation. The specific objectives of the test were as follows:

- Demonstrate the effectiveness of ZVI clay to degrade site-specific contaminants.
- Resolve the relative effectiveness of different sources of ZVI (Peerless, GMA, and QMP iron) at application rates of 1 and 3 percent.
- Investigate treatment performance with the addition of sodium bicarbonate and cement.
- Evaluate the use of cement to improve post-treatment soil strength.

Samples of soil, groundwater, and DNAPL were collected and shipped to CSU for use in the testing. The initial procedures for the test involved preparing a homogenous soil sample by first saturating the soil with groundwater, and then spiking with the DNAPL. The homogeneous soil sample was then loaded into 14 batch reactor vessels. A bench-scale mixing apparatus was used to mix soil within the reactors and deliver treatments into the soil. Following treatment via soil mixing, performance was monitored via soil samples collected after 0, 3, 14, 28, and 59 days. Soil samples were analyzed for TCE. Other treatment parameters that were monitored included chloride, pH, and oxidation-reduction potential (ORP).

The primary contaminant detected was TCE, with an initial concentration of approximately 350 mg/kg. In general, ZVI from GMA achieved the fastest degradation of TCE, followed by Peerless, then QMP. Faster reaction kinetics were achieved by using 3 percent versus 1 percent iron. The results of the testing are as follows:

- Resulting TCE concentrations at 59 days for different sources of ZVI and percentages:

	1 percent	**3 percent**
GMA Iron	48 mg/kg	0.11 mg/kg
Peerless Iron	190 mg/kg	12 mg/kg
QMP Iron	220 mg/kg	89 mg/kg

- Sodium bicarbonate addition (0.5 percent) did not significantly impact treatment.
- Cement addition (1 percent, local source) significantly inhibited the reaction rate.
- Other parameters including pH, ORP, and chloride concentrations provided evidence that TCE depletion is due to iron-mediated reductive dechlorination. Faster depletion in the treated soil versus in the no-iron control also indicates that iron is driving degradation.

Appendix C contains the report describing the procedures and results of the bench-scale evaluation of ZVI clay conducted by CSU.

2.4 Summary of Findings and Recommendations

The findings of the field investigation relative to the future pilot testing and the selection of the groundwater remedy include the following:

- Groundwater contamination is mainly related to the use of chlorinated solvents, primarily TCE and breakdown products, in manufacturing operations at OMC Plant 2. The groundwater investigations completed to date indicate that the distribution of CVOCs is limited in extent and appears as isolated areas rather than a single plume. Generally, these are Source Zones 1, 2, 3, 4, and 5 as defined in the RI (CH2M HILL, 2006b). The CVOC plume extending south of the building does not appear to have migrated far offsite and does not extend to Waukegan Harbor. The presence of TCE degradation compounds and results of natural attenuation parameters indicate that the TCE area is being degraded by anaerobic reductive dechlorination.

- PCB DNAPL was encountered during the groundwater investigation at MW-517D and was comprised of 1,100 grams per kilogram (g/kg) Aroclor 1248. The extent of dissolved-phased PCBs in the groundwater near MW-517D was investigated and not detected in the groundwater samples collected from wells immediately adjacent and downgradient of MW-517D; however, PCBs were detected in shallow groundwater at the MW-517 well nest (MW-517S). Upon completion of building demolition, the extent of the PCB DNAPL will be investigated to evaluate potential remedial technologies.
- LNAPL was encountered during the groundwater investigation at MW-503S and was comprised of Aroclor 1248, CVOCs, and other VOCs. The concentrations of compounds reported were not indicative of a free-phase liquid. In addition, the extent of LNAPL was not delineated at this time, but will be addressed after the building demolition activities are completed.
- The extent of DNAPL was delineated on the north and east in the eastern metal working area (Source Zone 2). The DNAPL area is estimated to be approximately 150 feet in the north-south direction and 70 feet in the east-west direction. The extent of the DNAPL beneath the building was larger than originally anticipated and extended into Source Zone 2 that was originally proposed as an injection area. Based on the potential impacts of DNAPL on the results of the injection, the pilot-test injection area was moved to the treatment area beneath the western portion of the building (Source Zone 5) where DNAPL has not been detected.
- The bench-scale evaluation conducted by CSU (Appendix C) indicated that ZVI clay can be an effective technology to use for remediation of the TCE DNAPL. Based on the location and extent of the DNAPL area beneath the building, however, the soil mixing pilot test should be delayed upon completion of the building demolition. The soil mixing process would reduce the strength of the soil potentially affecting the structural stability of the building wall. Evaluation of options and costs to structurally support the wall would significantly increase the pilot test costs.

SECTION 3

Natural Attenuation Evaluation

The baseline (February 2007) and annual (September 2007) groundwater monitoring data for the shallow and deep groundwater zones were collected to evaluate the occurrence of natural attenuation at the site.

3.1 Natural Annenuation

3.1.1 Natural Attenuation of Chlorinated Compounds

Monitoring and documentation of natural attenuation processes is known as monitored natural attenuation (MNA), which can achieve remediation objectives by reducing the mass, toxicity, mobility, volume, or concentration of contaminants within a timeframe that is reasonable compared to that offered by other, more active methods (USEPA, 1999). Ongoing natural attenuation can involve a number of interactive processes that may include dilution, adsorption, advection, and dispersion; volatilization; geochemical dynamics; and chemical or biological transformation (microbial attenuation). Biodegradation is often the most important process for compounds that can be transformed by indigenous microorganisms (Wiedemeier et al., 1996). At this site, the process of interest includes the degradation of TCE.

Natural attenuation will occur to some degree at any site, and the natural attenuation process helps to govern the nature and distribution of the contaminants in the subsurface environment. The magnitude of each individual natural attenuation process is governed by the prevailing site conditions and by the nature of the compound under study.

Microorganisms naturally occur in subsurface soil and sediment. Several conditions are necessary for microbial growth. First, there must be a carbon source or substrate available in a form that the microorganism can assimilate. Second, appropriate electron acceptors must be present to allow the microorganism to respire. Third, nutrients must be available to the microorganisms. The nutrients are typically available in the soil/sediment, and this condition is not rate limiting (DuPont, 1992).

Many microorganisms obtain energy by oxidizing organic substrates. Microorganisms perform this by transferring electrons from electron donors (e.g., the organic substrate) to compounds that accept electrons. Common electron acceptors include oxygen, nitrate, manganese (IV), iron (III), sulfate, and carbon dioxide. In natural aqueous systems, the use of electron acceptors in microbial metabolism tends to follow a natural succession corresponding with decreasing ORP. The succession starts with molecular oxygen (aerobic respiration) and nitrate (denitrification), and ends with sulfate (SO_4) (sulfate reduction) and carbon dioxide (methanogenesis). The electron acceptors will be reduced during respiration (e.g., nitrate to nitrite, sulfate to sulfite).

The biodegradation of TCE and its daughter products is possible by several mechanisms, including reductive dehalogenation, cometabolism, and direct oxidation. Reductive dehalogenation involves the transfer of electrons from a donor (e.g., organic substrate) to the CVOC acceptor, resulting in the replacement of chlorine with hydrogen. The process results in the formation of intermediate or daughter CVOCs. Significant anaerobic conditions (sulfate reducing or methanogenic) are required for reductive dehalogenation. The reductive dechlorination of TCE to ethene becomes progressively more difficult to carry out for each subsequent reaction. As a result, cis-1,2-DCE and vinyl chloride tend to accumulate in anaerobic environments (Wiedemeier et al., 1998).

Cometabolism is the transformation of CVOCs by nonspecific enzymes (oxygenases) produced by microbes during the metabolism of specific primary substrates (i.e., methane, toluene, phenol, propane, ethene, propene, cresol, ammonia, isoprene, etc.) under aerobic conditions. Cometabolism likely will occur only on the fringes of the area of CVOC detections where aerobic conditions are present. Rates of cometabolism increase as the number of chlorine atoms on the CVOC molecule decrease. TCE, DCE, and vinyl chloride can cometabolize under aerobic conditions, but is less likely due to the limited dissolved oxygen (DO) observed.

Direct oxidation involves the use of CVOCs as the sole source of carbon (primary substrate) by microbes. CVOCs are the primary substrate when they are the source of carbon and energy for the microbes. Aerobic conditions are necessary for direct oxidation. Only lesser chlorinated compounds, such as vinyl chloride, are susceptible to direct oxidation, and likely will occur only on the fringes of the area of CVOC detections where aerobic conditions exist.

3.1.2 Natural Attenuation Screening

The screening process outlined in the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (Wiedemeier et al., 1998) was used to evaluate the potential for reductive dechlorination at the site. The first step in this screening process was to examine the overall geochemical conditions to determine if the conditions are favorable for anaerobic biodegradation to occur. The second step compared the conditions within TCE plume areas and non-impacted areas.

During the RI, this technique was used to evaluate the site-wide potential for natural attenuation based on data collected during the April/May 2005 groundwater investigation. Based on those results and the natural attenuation evaluation, there was “adequate evidence” supporting anaerobic biodegradation of chlorinated organics in the shallow and deep groundwater at the site. As part of the pilot test investigation, additional data points became available that offered a better resolution of the contaminant plume for each of the source areas. Based on the availability of additional data for each source area and different site conditions for the source areas (free-phase vs. dissolved phase contamination and covered vs. non-covered scenarios), the natural attenuation evaluation was applied independently to each source area in an effort to better understand each specific source area’s potential for natural attenuation in the shallow and deep aquifers. This evaluation technique was applied to three known source areas: Source Zone 2 (TCE DNAPL plume) and Source Zones 4 and 5 (dissolved-phase TCE plumes). The anaerobic biodegradation screening process based on data for Source Zones 2, 4, and 5 are presented in Tables 3-1 to 3-6. The distribution of CVOCs in shallow and deep groundwater for the baseline and annual sampling event is presented on Figures 2-6 to 2-11 and Figures 2-12 to 2-17, respectively.

Using the methods presented by Wiedemeier and others (1998), data were compared to the preferred concentrations of natural attenuation indicator parameters for an overall screening of study area conditions. Monitoring wells sampled were divided based on depth to a shallow (0 to 15 feet below ground) and a deep (15 to 30 feet below ground) zone. The following sections summarize the results to the individual natural attenuation parameters based on data collected in February and September 2007.

Source Zone 2

For Source Zone 2, the "plume" or affected area is defined by locations with total CVOC concentrations exceeding 0.1 milligrams per liter (mg/L) (Figures 2-13 and 2-14) and includes nested Monitoring Wells MW-504, MW-511, MW-523, MW-524 (shallow only), MW-525, and MW-526.

TCE is present in both the shallow and deep zones of the aquifer; however, the concentrations are orders of magnitude greater in the deep zone. This is an area where there is known TCE DNAPL serving as a continued source for groundwater contamination. TCE and its daughter products, cis-1,2-DCE and vinyl chloride, provide evidence that TCE is undergoing biodegradation in this area.

Ethane and Ethene

Ethane and ethene, daughter products of vinyl chloride and the nontoxic end-products of the reductive dechlorination of TCE, were detected in the Source Zone 2 wells. The presence of these compounds is significant and is indicative of the chlorinated solvents undergoing biological transformation. In general, ethene was more frequently detected and at higher concentrations within the deep groundwater as compared to the shallow groundwater. Ethane was detected much less frequently than ethene and concentrations were slightly higher within the shallow aquifer.

Field Parameters (Dissolved Oxygen/Temperature/pH/Oxidation Reduction Potential)

DO concentrations in the groundwater less than 0.5 mg/L indicate that anaerobic conditions are present and the reductive dehalogenation pathway is possible. DO values greater than 5 mg/L indicate that aerobic conditions may prevail, preventing reductive dechlorination but allowing aerobic degradation of vinyl chloride. Because atmospheric oxygen can be easily introduced during sampling, other indicators of anaerobic conditions such as ORP, absence of nitrate, and presence of dissolved iron or dissolved manganese can also be used to evaluate the redox condition of the groundwater. In the shallow aquifer, DO measurements were typically greater than 0.5 mg/L, whereas in the deep aquifer, more than one half of the monitoring wells had DO values indicative of anaerobic conditions. DO concentrations in Area 2 remained relatively stable or decreased slightly from baseline conditions.

Temperatures in the shallow and deep aquifer were lower during baseline sampling than during annual sampling. Temperatures in the deep aquifer are below 20°C and, therefore, biochemical processes are not accelerated. Temperatures in the shallow aquifer were greater than 20°C during the annual event, potentially suggesting an acceleration of biological processes during this time. These locations are coincident with the lowest concentrations of TCE in the plume area (MW-523, -524, -525, and -526). The fluctuation in temperature, however, is more likely related to seasonal variations in temperature. All measurements of pH are within the optimum range for degradation (5 to 9).

The oxidation reduction (redox) potential, ORP, of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. Redox reactions in groundwater usually are biologically mediated and, therefore, the redox potential of a groundwater system depends upon and influences rates of biodegradation. The redox potential of groundwater generally ranges with values of -400 millivolts (mV) to 800 mV (Weidermeir et al., 1994). Reductive dechlorination may occur under a wide range of anaerobic redox conditions but is possible at values less than 50 mV. In the plume area, positive ORP results were typically measured in the shallow aquifer. Negative ORP was observed at levels generally less than -100 mV in the deep aquifer suggesting that redox conditions are conducive to reductive dechlorination.

Nitrate

When present at higher concentrations (greater than 1 mg/L), nitrate may compete with the reductive pathway of contaminants. Nitrate concentrations in both the shallow and deep aquifers are predominantly less than 1 mg/L, which is indicative of reductive dechlorination, and generally consistent with baseline conditions.

Dissolved Manganese

Increases in soluble manganese concentrations indicate reductive dechlorination processes may be occurring. Dissolved manganese was found at elevated concentrations in the shallow aquifer at Monitoring Wells MW-511 and MW-504 (0.29 to 0.48 mg/L) and the deep aquifer MW-523 and MW-525 (0.37 to 0.38 mg/L) in the area of highest CVOC concentrations. The upgradient and crossgradient locations ranged from 0.18 mg/L to 0.31 mg/L in the shallow aquifer and from non-detect to 0.16 mg/L in the deep aquifer. The distribution of higher dissolved manganese concentrations in the area of highest CVOC detections relative to upgradient and crossgradient locations, especially in the deep aquifer, indicates that manganese reduction has occurred and reductive dechlorination of the CVOCs is possible.

Iron II

Iron (III) can be used as an electron acceptor where it is reduced to iron (II) and accumulates at elevated concentrations. Similar to nitrate concentrations, the iron (II) concentrations are conducive to reductive dechlorination processes. Iron concentrations in the shallow aquifer are generally present in concentrations less than 1 mg/L, whereas iron concentrations in the deep aquifer are generally greater than 1 mg/L. Iron concentrations in the deep aquifer increased from baseline conditions. These elevated concentrations in the deep aquifer indicate reducing conditions and are a possible indicator of anaerobic degradation and reductive dechlorination of vinyl chloride.

Sulfate

Sulfate can also be used as an electron acceptor once oxygen and nitrate are depleted. Sulfate levels above 20 mg/L may result in competitive exclusion of reductive dechlorination. In particular, reductive dechlorination for cis-1,2-DCE is slower under sulfate reducing conditions. Sulfate concentrations are generally greater than 20 mg/L in both the shallow and deep aquifers within the plume area. In addition to sulfate analyses, a reduced form, sulfide, also was analyzed. It was not detected in shallow or deep monitoring wells, thus it is unlikely that sulfate reduction is occurring in Source Zone 2.

Methane

Methane was generally found to be present in low concentrations in the shallow and deep aquifers. Within the plume area, methane concentrations are typically less than 0.5 mg/L, indicating that anaerobic biodegradation by methanogenesis is not likely occurring. No distinct trends between sampling events were observed in the deep aquifer, but methane concentrations were consistently lower during the annual sampling event in the shallow aquifer.

Alkalinity

High alkalinity is evidence of reductive dechlorination because microbial respiration releases carbon dioxide into the groundwater. The carbon dioxide reacts with water to form an acid that dissolves carbonate materials in the aquifer matrix. Dissolution of those materials results in higher concentrations of calcium and magnesium, and thus increased alkalinity. There were no significant elevated concentrations of alkalinity in the plume area when compared to upgradient concentrations and concentrations were comparable to baseline results.

Total Organic Carbon (TOC)

TOC is a general measure of organics, including naturally occurring organics and anthropogenic organic sources that could include CVOCs and petroleum-related VOCs. These measurements do not distinguish between the types of organic compounds present. TOC values in the plume area monitoring wells are low (less than 10 mg/L), suggesting that the availability of electron donors (organic substrate) is low in the shallow and deep aquifers.

Chloride

Chloride is released to groundwater during the reductive dechlorination of CVOCs. Within the plume area, none of the monitoring wells had concentrations equal to or greater than twice the background concentration. No discernable trends were observed upon comparison to baseline conditions in the shallow aquifer, but concentrations in the deep aquifer were higher than baseline during the annual sampling.

Source Zone 4

For this evaluation, the "plume" or affected area is defined by locations with total CVOC concentrations exceeding 0.1 mg/L (Figures 2-15 and 2-16) and includes nested Monitoring Wells MW-011, MW-512, MW-514, MW-527, MW-528, and MW-529.

TCE is only found in the shallow aquifer, with the exception of MW-528 in the deep aquifer. TCE daughter products, cis-1,2-DCE and vinyl chloride, were detected. Cis-1,2-DCE and vinyl chloride are detected in more locations and have a greater distribution than TCE. The presence of cis-1,2-DCE and vinyl chloride provide evidence that TCE is undergoing biodegradation in this area.

Ethane and Ethene

In general, ethene was detected at higher concentrations within the deep groundwater as compared to the shallow groundwater. Ethane was detected at higher concentrations within the shallow groundwater as compared to the deep groundwater. The presence of ethene/ethane in groundwater provides evidence that CVOCs are being dechlorinated to environmentally inert end products.

Field Parameters (Dissolved Oxygen/Temperature/pH/Oxidation Reduction Potential)

DO concentrations in Area 4 remained relatively stable or decreased slightly from baseline conditions. In both the shallow and deep aquifers, DO measurements were typically less than 1 mg/L, but DO values in the deep aquifer were slightly more indicative of anaerobic conditions. Minor fluctuations in DO readings in Area 4 are anticipated as this area is unpaved allowing more infiltration than those covered by pavement or buildings.

Temperatures in the shallow aquifer during baseline sampling were lower than the deep aquifer, but were either greater than 20ºC or approaching 20ºC in September, potentially suggesting an acceleration of biological processes. The fluctuation in temperature, however, is likely more related to seasonal variations in temperature and the unpaved surface which allows more infiltration of water at atmospheric temperature. Temperatures in the deep aquifer are below 20ºC and, therefore, biochemical processes are not accelerated. All measurements of pH are within the optimum range for degradation (5 to 9).

In the plume area, ORP measurements in the shallow aquifer were typically less than 50 mV suggesting that reductive dechlorination is possible. Negative ORP was observed at levels less than -100 mV in the deep aquifer suggesting that redox conditions are near optimal for reductive dechlorination. In addition, ORP measurements collected in the deep aquifer during the annual sampling were more negative than baseline conditions, suggesting an increased rate of biodegradation. The ORP values in the shallow aquifer showed no discernable pattern. Results of field measurements of DO and ORP support the occurrence of reductive dehalogenation in the area of CVOC detection. The decreasing ORP measurements are likely related to the injection of sodium lactate in this area.

Nitrate

When present at higher concentrations (greater than 1 mg/L), nitrate may compete with the reductive pathway of contaminants. Nitrate concentrations in both the shallow and deep aquifers are predominantly below 1 mg/L, which is indicative of reductive dechlorination. In general, concentrations of nitrate in the shallow aquifer increased slightly over baseline conditions, but MW-527S and MW-529S increased by an order of magnitude. Nitrate remained relatively stable in the deep aquifer.

Dissolved Manganese

Dissolved manganese concentrations in Area 4 shallow monitoring wells were generally consistent with baseline concentrations. The highest concentrations of dissolved manganese are found in the shallow aquifer, with concentrations ranging from 0.35 to 1.00 mg/L and from non-detect to 0.25 mg/L in the deep aquifer. In general, the dissolved manganese concentrations in the background locations seem to be slightly lower (less than an order of magnitude) compared to source area values, indicating that manganese reduction has likely not occurred, but reductive dechlorination of the CVOCs is possible.

Iron II

Iron reduction is less significant (lower concentrations of dissolved iron) in shallow and more significant (higher concentrations of dissolved iron) in deep monitoring wells. The soluble iron concentrations in deep monitoring wells in Area 4 indicate conditions conducive to reductive dechlorination processes and anaerobic degradation (more than 1 mg/L) while concentrations of soluble iron remain below 1 mg/L in the shallow monitoring wells.

Sulfate

Sulfate concentrations increased in the shallow monitoring wells from baseline conditions whereas concentrations decreased in the deep aquifer. Sulfate concentrations are slightly lower in the shallow aquifer compared to the deep aquifer. Current sulfate concentrations are typically below 20 mg/L and are not likely to result in competitive exclusion of reductive dechlorination. In addition to sulfate analyses, a reduced form, sulfide, also was analyzed. It was only detected in one deep monitoring well, thus it is unlikely that significant sulfate reduction is occurring in Source Zone 2.

Methane

Methane was generally found to be present in the shallow and deep aquifers but decreased from baseline conditions. The declines in methane concentrations combined with the elevated concentrations of sulfate indicate that the reducing environment may not be strong enough to produce methanogenic conditions.

Alkalinity

High alkalinity is evidence of reductive dechlorination because microbial respiration releases carbon dioxide into the groundwater. Alkalinity measurements were generally consistent in the shallow aquifer compared to baseline conditions. There were no significant elevated concentrations of alkalinity (more than twice the background concentration) in the plume area when compared to upgradient concentrations. However, Monitoring Wells MW-527D, MW-529D and MW-514D in the deep aquifer showed increased concentrations that may be attributed to enhanced reducing conditions.

TOC

In general, TOC concentrations in both the shallow and deep aquifers have increased from baseline conditions. However, TOC values in the shallow plume area remain less than 10 mg/L, suggesting that the availability of electron donors (organic substrate) is low in the shallow aquifer. In the deep aquifer, half of the wells during the annual sampling had TOC concentrations greater than 20 mg/L suggesting that there is an energy source (e.g., the sodium lactate) present to drive dechlorination.

Chloride

Chloride is released to groundwater during the reductive dechlorination of CVOCs. Within the plume area, none of the monitoring wells had concentrations equal to or greater than twice the background concentration and no discernable trends were observed upon comparison to baseline conditions.

Source Zone 5

For this evaluation, the “plume” or affected area is defined by locations with total CVOC concentrations exceeding 0.1 mg/L (Figures 2-17 and 2-18) and includes nested Monitoring Wells MW-503 (deep only), MW-505, MW-506, MW-518, MW-520, MW-520, MW-521, and MW-522.

TCE is present in both the shallow and deep aquifers; however, the concentrations are orders of magnitude greater in the deep zone. TCE and its daughter products, cis-1,2-DCE and vinyl chloride, were detected. The presence of cis-1,2-DCE and vinyl chloride provide evidence that TCE is undergoing biodegradation in this area.

Ethane and Ethene

In general, ethene was more frequently detected and at higher concentrations within the deep groundwater as compared to the shallow groundwater. Ethane was detected much less frequently than ethene and concentrations were slightly higher within the shallow aquifer.

Field Parameters (Dissolved Oxygen/Temperature/pH/Redox Potential)

DO concentrations in Area 5 remained relatively stable or decreased slightly from baseline conditions. DO concentrations in the groundwater less than 0.5 mg/L indicate that anaerobic conditions are present and the reductive dehalogenation pathway is possible. In both the shallow and deep aquifers, DO measurements were typically near or less than 1 mg/L.

Temperatures in the shallow and deep aquifer were lower during baseline sampling than during annual sampling, but temperatures were consistent between the shallow and deep aquifer for each event. Temperatures in the shallow and deep aquifers are typically below 20^{o}C and, therefore, biochemical processes are not accelerated. All measurements of pH are within the optimum range for degradation (5 to 9).

ORP measurements in Area 5 decreased from baseline conditions. In the plume area, ORP levels were observed at levels less that -100 mV in both the shallow and deep aquifer during the annual event, suggesting that redox conditions are near optimal for reductive dechlorination at that time. Although ORP readings were not typically -100 mV during the baseline sampling, they were less than 50 mV suggesting that reductive conditions are possible. Results of field measurements of DO and ORP also support the occurrence of reductive dehalogenation in the area of CVOC detection.

Nitrate

When present at higher concentrations (greater than 1 mg/L), nitrate may compete with the reductive pathway of contaminants. Nitrate concentrations in both the shallow and deep aquifers are predominantly below 1 mg/L, which is indicative of reductive dechlorination, and showed only insignificant increases in concentrations from baseline conditions.

Dissolved Manganese

Dissolved manganese concentrations in Area 5 shallow monitoring wells were generally consistent with baseline concentrations in the shallow aquifer, but were slightly lower (less than an order of magnitude) in the deep aquifer and the background locations. With the exception of MW-503D, the highest concentrations of dissolved manganese are found in the shallow aquifer, with concentrations ranging from 0.14 to 0.50 mg/L and from non-detect to 0.8 mg/L in the deep aquifer. Concentrations of dissolved manganese in Area 5 indicate that manganese reduction has not occurred and reductive dechlorination of the CVOCs is not likely at this time. Concentrations of dissolved manganese in deep monitoring wells declined over baseline concentrations.

Iron II

Iron concentrations in the shallow and deep aquifers are greater than 1 mg/L, indicating iron reduction is significant in Area 5. Concentrations of soluble iron in shallow monitoring wells have generally remained steady relative to baseline concentrations. Concentrations of soluble iron in the five deep monitoring wells have shown increasing trends over baseline concentrations. These elevated concentrations indicate reducing conditions and are a possible indicator of anaerobic degradation and reductive dechlorination of vinyl chloride.

Sulfate

Sulfate concentrations are slightly lower in the shallow aquifer compared to the deep aquifer and typically below 20 mg/L; therefore, it is not likely to result in competitive exclusion of reductive dechlorination. Sulfate concentrations in the deep aquifer are greater than 20 mg/L and may result in competitive exclusion of reductive dechlorination. In general, concentrations vary widely in the shallow and deep monitoring wells and no major trends were observed when compared to baseline conditions. In addition to sulfate analyses, a reduced form, sulfide, also was analyzed. There were only three low-level detections of sulfite, thus it is unlikely that sulfate reduction is occurring in Source Zone 5.

Methane

Methane generally was present in the shallow and deep aquifers at concentrations greater than 0.5 mg/L. Within the plume area, methane ranged from 0.13 mg/L to 2.2 mg/L in the shallow aquifer and from 0.14 mg/L to 1.2 mg/L in the deep aquifer, indicating that anaerobic biodegradation by methanogenesis may be occurring. It should be noted that methane concentrations do appear to be decreasing from baseline conditions, particularly in the deep aquifer.

Alkalinity

High alkalinity is evidence of reductive dechlorination because microbial respiration releases carbon dioxide into the groundwater. There were no significant elevated concentrations of alkalinity in the plume area when compared to upgradient concentrations, however, alkalinity concentrations increased slightly in both the shallow and deep aquifers relative to baseline conditions.

Total Organic Carbon

TOC concentrations in the plume area were typically less than 20 mg/L in the shallow aquifer and less than 10 mg/L in the deep aquifer, suggesting that the availability of electron donors (organic substrate) is low. The TOC concentrations are slightly higher in both the shallow and deep aquifers relative to baseline conditions.

Chloride

Chloride is released to groundwater during the reductive dechlorination of CVOCs. Within the plume area, none of the monitoring wells had concentrations equal to or greater than twice the background concentration. Chloride concentrations in the shallow and deep wells have remained relatively consistent with baseline concentrations.

3.1.3 Data Interpretation Summary

Review of the groundwater monitoring results shows that the site contains many reducing environment characteristics conducive to reductive dechlorination of CVOCs. TCE and its daughter products, cis-1,2-DCE and vinyl chloride, and the presence of ethane/ethenes provide evidence that active biodegradation of TCE is occurring at the site. It appears that the site contains many reducing environment characteristics conducive to reductive dechlorination of CVOCs. Reducing conditions increase with depth at the site and few locations across the site represent aerobic conditions. The results of the natural attenuation screening of September 2007 data for each source zone are as follows:

Source Zone 2

Screening results for the shallow and deep aquifers in Source Zone 2 show there is “limited” evidence in the shallow zone and “adequate” evidence in the deep zone for anaerobic biodegradation of chlorinated “parent” products (TCE) by anaerobic reductive dechlorination and other natural attenuation processes. Comparison of the baseline data to that of September 2007 supports these conclusions. Evaluation of data show a decrease in TCE concentrations (significant reduction in the deep zone) and stable to decreasing cis-1,2-DCE concentrations. Vinyl chloride concentrations in the deep zone appear to be moderately decreasing near the source and moderately increasing downgradient of the source. Vinyl chloride concentrations in the shallow zone are stable.

Nitrate concentrations were observed as less than 1 mg/L across the area, allowing for favorable conditions of natural attenuation. In addition, the deep zone exhibited the additional presence of dissolved iron (generally observed at more than 1 mg/L) that is also indicative of active reductive dechlorination. Ethene, a final end product of vinyl chloride, was detected frequently in the deep zone providing further support for reductive dechlorination.

Source Zone 4

Screening results for the shallow and deep aquifers in Source Zone 4 show there is limited evidence in the shallow zone and strong evidence in the deep zone for anaerobic biodegradation of chlorinated “parent” products (TCE) by anaerobic reductive dechlorination and other natural attenuation processes. Evaluation of the data show a decrease in TCE concentrations (except MW-511 increased), moderate changes in cis-1,2-DCE concentrations, and increasing concentrations of vinyl chloride. The reduction in TCE and increase in vinyl chloride provide strong evidence to support active reductive dechlorination and the conclusions of the natural attenuation evaluation.

Nitrate concentrations were observed as less than 1 mg/L across the area, allowing for favorable conditions of natural attenuation. In addition, the deep zone exhibited the additional presence of dissolved iron (generally observed at more than 1 mg/L) which is also indicative of active reductive dechlorination. Ethene and ethane, final end products of vinyl chloride, were detected frequently in the deep and shallow zones, respectively, providing further support for reductive dechlorination.

Source Zone 5

Screening results for the shallow and deep aquifers in Source Zone 5, there is adequate evidence for anaerobic biodegradation of chlorinated “parent” products (TCE) by anaerobic reductive dechlorination and other natural attenuation processes. Evaluation of the data shows no significant change in TCE concentrations (except MW-522 increased). It should be noted that TCE concentrations in the shallow zone are negligible. In the shallow zone, cis-1,2-DCE is slightly increasing and vinyl chloride is increasing. In the deep zone, cis-1,2-DCE is decreasing to significantly decreasing. The vinyl chloride is decreasing near the source and increasing downgradient of the source. The reduction in TCE and increase in vinyl chloride provide strong evidence to support active reductive dechlorination and the conclusions of the natural attenuation evaluation.

In addition, nitrate concentrations were observed as less than 1 mg/L across the area, allowing for favorable conditions of natural attenuation. The presence of dissolved iron (generally observed at more than 1 mg/L) and sulfate values observed (generally observed less than 20 mg/L in shallow groundwater) is also indicative of active reductive dechlorination. Ethene/ethane and methane were detected frequently in the shallow zone and ethene and methane were frequently detected in the deep zone, indicating that methanogenic conditions exist beneath the northern portion of Plant 2, in Source Zone 5. Methane is produced by the metabolism of a wide range of organic substrates by methanogenic bacteria. This group of bacteria is known to play a role in CVOC attenuation.

SECTION 4

Fate and Transport Modeling

This section presents the methodology and results of the fate and transport modeling of CVOC in the groundwater beneath the OMC Plant 2 site. The physical and chemical data collected during the RI and the pilot test activities were used as inputs and to calibrate the model. The modeling was performed to examine how far the chlorinated solvent plume will extend and how much time will be needed for TCE, cis-1,2-DCE, and vinyl chloride concentrations to achieve steady-state conditions if no engineering controls or source zone reductions are implemented.

4.1 Evaluation Approach

To evaluate the fate and transport of TCE, cis-1,2-DCE, and vinyl chloride, physical (advection and dispersion) and chemical (adsorption) processes along with biological processes (degradation) need to be considered. The BIOCHLOR Natural Attenuation Decision Support System, Version 2.2 (developed for the Air Force Center for Environmental Excellence Technology Transfer Division) was selected for the modeling. BIOCHLOR is a screening model that simulates remediation by natural attenuation of dissolved solvents in groundwater. The software, programmed in the Microsoft© Excel spreadsheet environment and based on the Domenico analytical solute transport model, has the ability to simulate one-dimensional advection, three-dimensional dispersion, linear adsorption, and biotransformation via reductive dechlorination (the dominant biotransformation process at most chlorinated solvent sites). Dissolved solvent degradation is assumed to follow a sequential first-order decay process. The BIOCHLOR software includes three different model types:

1. **Solute transport without decay**—Predicts movement of conservative (non-degrading solute).
2. **Solute transport with biotransformation modeled as a sequential first-order decay process in one zone**—Accounts for the reactive transport of both parent and daughter chlorinated solvents. One set of rate constants is used within the entire model area.
3. **Solute transport with biotransformation modeled as a sequential first-order decay process in two different reaction zones**—Allows the use of two different sets of rate constants within the model area.

For calibration to OMC Plant 2 data, the second model type was used for the anaerobic zone along the plume center axis from the source zone to downgradient monitoring well locations. Typically, a chlorinated solvent plume would be simulated using the Type 3 model; however, sufficient downgradient data are not available to indicate whether an aerobic second zone is present.

Limitations to the BIOCHLOR model are that it assumes simple groundwater flow conditions and uniform hydrogeologic and environmental conditions exist over the entire model area. Hence, BIOCHLOR only approximates complex processes that may be occurring in the field. This model, however, was designed specifically for simulating the sequential reductive dehalogenation of chlorinated ethenes, such as those observed at the OMC Plant 2 site.

4.2 Model Input Parameters

The model input parameters are a combination of site-specific measurements and generic literature values, if site-specific data are not available. The simulated migration pathway is assumed to be from identified source zones along the centerline of the existing plume to the furthest downgradient wells.

4.2.1 Source and Plume Areas

The data gathered during the DNAPL delineation and pilot test activities conducted in 2006 and 2007 were used to refine the extent of the source zones and the plume areas for the modeling. These specific data include the additional DNAPL investigation, observations during the installation of monitoring and injection wells, and the CVOC results from the baseline sampling event conducted in February 2007. Each of the source zone areas is discussed below. The concentrations used for the source zones and the downgradient monitoring wells used to calibrate the model are presented in Table 4-1.

4.2.2 Source Zone 1

Source Zone 1 is located beneath the chip wringer room and the former TCE UST. In March 2007, LNAPL was observed in MW-503S and contained CVOCs including 1,1,1-trichloroethane (610 mg/kg), cis-1,2-DCE (830 mg/kg), TCE (4.4 mg/kg), and vinyl chloride (120 mg/kg). A plume emanating from a release around MW-503S is not evident from the CVOC concentrations within the shallow zone (upper 15 feet of the aquifer) downgradient of MW-503S. The deep zone in Source Zone 1 contains elevated concentrations of cis-1,2-DCE (170 mg/L in MW-503D and 240 mg/L in MW-506D) and vinyl chloride (7.7 mg/L in MW-503D and 30 mg/L in MW-506D). The TCE concentrations were relatively low with a maximum concentration of 0.640 mg/L in MW-518D. This area was not modeled because the size of the source and plume areas could not be estimated.

4.2.3 Source Zone 2

The simulated migration pathway for Source Zone 2 begins at the source, estimated to be the delineated DNAPL area and ends about 300 feet downgradient in the vicinity of MW-511, immediately upgradient of Source Zone 3. Water quality results from wells monitored in 2007 along this pathway (MW-523D, MW-525D, and MW-511D) were used in the model calibration. Based on the presence of DNAPL at the base of the aquifer, only deep concentration data were used to calibrate the model.

The Source Zone 2 source release was modeled as a continuous and constant release of the CVOCs beginning about 30 years ago (1977 to 2007). As a point of calibration, the release is estimated to have occurred at MW-523D (TCE concentration of 210 mg/L). Based on existing data for Source Zone 2, it is assumed that the release has resulted in a source zone plume of about 100 feet wide based on the estimated extent of the DNAPL area (Figure 4-1) and is 15 feet thick (that is, the lower half of the aquifer).

4.2.4 Source Zone 3

Source Zone 3, located beneath the trim building and Triax Building immediately downgradient of the DNAPL area (Source Zone 2), was identified during the MIP investigation. Based on the future use of the Triax Building for the groundwater treatment system for the Waukegan Coke Plant site, monitoring wells were not installed within this area. Source Zone 3 was not modeled because the size of the source and plume areas could not be estimated.

4.2.5 Source Zone 4

The specific source for the Source Zone 4 plume has not been identified. The Source Zone 4 plume was modeled assuming that the most upgradient high concentration monitoring well (MW-529S) represents the source. The source release also was modeled as a continuous and constant release of the CVOCs beginning about 30 years ago. The simulated migration pathway for Source Zone 4 extends south through MW-516S and ends about 450 feet downgradient at the Waukegan Harbor discharge zone (Figure 4-2). Water quality results from wells monitored in 2007 along this pathway (MW-529S, MW-527S, and MW-516S) were used in the model calibration. Because the shallow aquifer has the greatest concentrations along this pathway, only the shallow concentration data were used to calibrate the model.

4.2.6 Source Zone 5

The simulated migration pathway for Source Zone 5 begins at the source, estimated to be upgradient of MW-505D and ends about 1,400 feet downgradient at MW-516 on the Larsen Marine Service property. The 2007 water quality results from monitoring wells along this pathway (MW-522D, MW-521D, MW-510D, MW-513D, and MW-516D) were used to calibrate the model to site conditions. BIOCHLOR models the plume as a single layer and does not account for contaminant migration at different depths. A comparison of the shallow and deep TCE results indicates that the elevated TCE concentrations related to Source Zone 5 were only detected in the deeper portion of the aquifer, so only deep concentration data were used to calibrate the model.

The source release is modeled as a continuous and constant release of the CVOCs beginning about 30 years ago. As a point of calibration, the release is estimated to have occurred approximately halfway between MW-519D (TCE concentration of 0.016 mg/L) and MW-505D (TCE concentration of 41 mg/L) and is assumed to exceed the maximum TCE concentration detected in the area (TCE concentration of 44 mg/L at MW-520D) in February 2007. Based on existing data for Source Zone 5, it is assumed that the release has resulted in a source zone plume of about 300 feet wide (Figure 4-3) and 15 feet thick (that is, the lower half of the aquifer).

4.3 Physical and Chemical Inputs

The BIOCHLOR model also requires hydrogeologic data, estimates of dispersivity, and distribution coefficients to approximate the physical and chemical process affecting the fate and transport of CVOCs from the source zones. The input data for the different source zones are summarized in Table 4-2.

The BIOCHLOR model uses a single retardation factor (Rf) for the compounds rather than individual factors. The Rf value of 1.72 used in the modeling was calculated using literature-based partitioning coefficients and the average TOC and bulk density estimated from soil data collected during the RI (CH2M HILL, 2006b).

4.4 Modeling Procedure

The hydraulic and physical data collected at the site during the RI or the pilot test activities were used in the model (Tables 4-1 and 4-2). In the initial model run for each area, half-lives for TCE, cis-1,2-DCE, and vinyl chloride were iteratively entered until the modeled concentrations predicted the observed concentrations along the simulated centerline of the plume at a simulation time of 30 years. The half-lives are generally within the typical range cited in literature for Source Zones 2 and 5, but are much lower for Source Zone 4 where the shallow zone was modeled.

4.5 Results

Using the input parameters described above, the model was used to simulate concentrations of TCE, cis-1,2-DCE, or vinyl chloride beginning in 1977 (Year 1 in the model) and for the next 30 years after the release (1977 to 2007) along the simulated plume centerline. The BIOCHLOR spreadsheets for the different area model runs are provided in Appendix D.

4.5.1 Source Zone 2

The observations of modeling of Source Zone 2 are as follows:

- Calibration of modeled results to measured concentrations 100 feet downgradient of the source location (MW-525D) was difficult. This is likely because DNAPL is present some distance downgradient of the assumed source location (MW-523D). As a result, calibration focused on matching concentrations measured at 300 feet downgradient (MW-511D).
- The modeling results indicate that biodegradation is effectively reducing the plume mass and is limiting the downgradient extent of the plume from the source zones. The modeled plume reaches its maximum extent of about 400 feet at about year 40, or 10 years from today. The modeled plume does not reach Waukegan Harbor located about 1,050 feet downgradient of the source.
- The model results indicate the relatively slow migration velocity of the CVOCs (about 9 feet per year) combined with biodegradation has resulted in the current plume to be near steady-state conditions. In essence, the plume is not expected to expand

appreciably from its current dimensions and concentrations. The CVOC concentrations within the plume are expected to remain at these elevated levels for decades, because without any source control measures, the DNAPL will serve as a continuous source for decades.

4.5.2 Source Zone 4

The modeling of Source Zone 4 did not provide as good a fit as the modeling of the other source zones (Source Zones 2 and 5). The high hydraulic conductivity of 0.031 cm/sec estimated for the shallow zone in this area results in rapid groundwater migration in the shallow zone (CVOC migration velocity of about 210 feet per year). The high groundwater and contaminant migration velocities result in the plume reaching its discharge location in about 2 years, providing insufficient time for biodegradation to occur. The observed concentrations of CVOCs, however, are less than detection limits (0.0005 mg/L) at MW-516S, suggesting remarkably high degradation rates. The resulting calibrated degradation rates are half-lives on the order of 1 month or less. These degradation rates are faster than values typically seen in literature (Table 4-3) and may be caused by the following:

- The actual hydraulic conductivity of the migration pathway is lower, providing more time for the observed biodegradation. Decreasing the estimated hydraulic conductivity would yield degradation rates more consistent with typical literature rates.
- The actual migration pathway includes flow paths within the shallow zone and the less permeable deeper zone of the aquifer. As above, this results in more acceptable degradation rates.

4.5.3 Source Zone 5

The observations of modeling of Source Zone 5 are as follows:

- Source Zone 5 provides the longest plume centerline from a single source to the discharge boundary. The concentration data along the plume do not indicate commingling plumes from different sources.
- The modeling results for the deep zone of Source Zone 5 indicates that biodegradation is effectively reducing the plume mass and is limiting the downgradient extent of the plume from each of the source zones. The modeled plume reaches its maximum extent of about 400 feet between years 20 and 30. In essence, the model shows that the current plume has likely reached its maximum extent. The modeled plume does not reach Waukegan Harbor located about 1,000 feet downgradient of the source.
- Different half-lives for the CVOCs were needed to calibrate the model for the deep zone of Source Zone 5 compared to Source Zone 2, indicating that the subsurface conditions relative to biodegradation are not uniform across the site. This may be a reflection of the differences in the sources (for example, DNAPL in the vicinity of Source Zone 2) and groundwater velocities of the individual areas.

SECTION 5

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Tables

TABLE 2-1
Analytical Objectives for Groundwater Samples
OMC Plant 2

Parameter - TCL VOCs (CLP SOW SOM01.1)	CAS No.	USEPA Region 9 PRG Tap Water (µg/L)	IEPA Tier 1 TACO Groundwater Class 1 (µg/L)	Contract Required Quantiation Limit (CRQL) (µg/L)
Acetone	67-64-1	5475	700	5.0
Benzene	71-43-2	0.35	5.0	0.5
Bromodichloromethane	75-27-4	0.18	0.2	0.5
Bromoform (tribromomethane)	75-25-2	8.51	1	0.5
Bromomethane (Methyl bromide)	74-83-9	8.66	---	0.5
Bromochloromethane	74-97-5	---	---	0.5
2-Butanone (Methyl ethyl ketone)	78-93-3	6968	---	5.0
Carbon disulfide	75-15-0	1043	700	0.5
Carbon tetrachloride	56-23-5	0.17	5.0	0.5
Chlorobenzene	108-90-7	106	100	0.5
Chloroethane	75-00-3	4.64	---	0.5
Chloroform	67-66-3	0.17	0.2	0.5
Cyclohexane	110-82-7	10342	---	0.5
Chloromethane (methyl chloride)	74-87-3	158	---	0.5
Dibromochloromethane	124-48-1	0.13	---	0.5
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	0.05	0.2	0.5
1,2-Dichlorobenzene	95-50-1	370	600	0.5
1,3-Dichlorobenzene	541-73-1	183	---	0.5
1,4-Dichlorobenzene	106-46-7	0.50	75	0.5
1,1-Dichloroethane	75-34-3	811	700	0.5
1,2-Dichloroethane (EDC)	107-06-2	0.12	5.0	0.5
1,2-Dibromoethane (EDB)	106-93-4	0.01	---	0.5
1,1-Dichloroethylene	75-35-4	339	7.0	0.5
1,2-Dichloroethylene (cis)	156-59-2	61	70	0.5
1,3-Dichloropropene (cis)	10061-01-5	---	---	0.5
1,2-Dichloroethylene (trans)	156-60-5	122	100	0.5
1,2-Dichloropropane	78-87-5	0.16	5.0	0.5
Ethylbenzene	100-41-4	1340	700	0.5
2-hexanone	591-78-6	---	---	5.0
Methyl isobutyl ketone	108-10-1	1993	---	5.0
Methylene chloride	75-09-2	4.28	5.0	0.5
Methylcyclohexane	108-87-2	5217	---	0.5
Methyl tertbutyl ether (MTBE)	1634-04-4	11.00	---	0.5
Methyl acetate	79-20-9	6083	---	0.5
Isopropylbenzene (Cumene)	98-82-8	658	---	0.5
1,1,2,2-Tetrachloroethane	79-34-5	0.06	---	0.5
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	59180	---	0.5
Styrene	100-42-5	1641	---	0.5
Tetrachloroethylene (PCE)	127-18-4	0.10	5.0	0.5
Toluene	108-88-3	723	1000	0.5
Trichlorofluoromethane	75-69-4	1288	---	0.5
1,2,4-Trichlorobenzene	120-82-1	7.16	70	0.5
1,2,3-Trichlorobenzene	87-61-6	---	---	0.5
1,1,1-Trichloroethane	71-55-6	3172	200	0.5
1,1,2-Trichloroethane	79-00-5	0.20	5.0	0.5
Trichloroethylene (TCE)	79-01-6	0.03	5.0	0.5
Vinyl chloride (child/adult)+++	75-01-4	0.02	2.0	0.5
Xylenes	1330-20-7	206	10,000	0.5

"---"   indicates no limit identified

TABLE 2-2

February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-003D	MW-003S	MW-011D	MW-011S	MW-014D	MW-014S	MW-015S	MW-500D	MW-500S	MW-501D	MW-501S
		Sample Date>>	2/27/2007	2/27/2007	2/23/2007	2/23/2007	2/23/2007	2/23/2007	2/22/2007	2/20/2007	2/20/2007	2/20/2007	3/22/2007
Analyte	Units	Screening Level											
VOCs													
1,1-DICHLOROETHYLENE	µg/L	7	8 U	0.5 U	0.5 U	**15** J	0.5 U	0.5 U	0.95 U	0.5 U	0.5 UJ	1.4 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.12	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	0.5	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
ACETONE	µg/L	700	80 U	5 U	5 U	5 UJ	5 U	5 U	9.5 U	5 U	**2.7** J	14 U	5 U
BENZENE	µg/L	0.35	**190** J	0.5 U	0.5 U	0.5 U	**28**	0.5 U	0.95 U	**0.95**	0.5 U	1.4 U	0.5 U
CHLORODIBROMOMETHANE	µg/L	0.18	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
CHLOROETHANE	µg/L	4.64	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	**0.58** J	0.5 U
CHLOROFORM	µg/L	0.17	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	8 U	**41**	**4.7** J	**1,700**	**1.3** J	**0.48** J	**3.1** =	**2.7**	**4.3**	1.4 U	**33**
CHLORIDE)	µg/L	4.28	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.68** J	0.5 U	0.5 U	1.4 U	**1.1**
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	8 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	8 U	**0.24** J	0.5 U	**7.6** J	0.5 U	0.5 U	0.95 U	0.5 U	0.5 U	1.4 U	0.5 U
TRICHLOROETHYLENE	µg/L	0.03	8 U	0.5 U	**0.32** J	**30** J	**0.26** J	0.5 U	**18** =	0.5 U	0.5 U	1.4 UJ	0.5 U
VINYL CHLORIDE	µg/L	0.02	8 U	**4.5**	**120**	**120**	**2.4** J	**0.48** J	0.95 U	**12**	**6.6**	**31**	**1.3**

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-2

February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-502D	MW-502S	MW-503D	MW-504D	MW-504S	MW-505D	MW-506D	MW-506S	MW-507D	MW-507S	MW-509D	MW-509S 2/22/2007
		Sample Date>>	2/20/2007	2/20/2007	2/26/2007	2/19/2007	2/19/2007	2/22/2007	2/26/2007	2/26/2007	2/21/2007	2/21/2007	2/22/2007	2/22/2007
Analyte	Units	Screening Level												
VOCs														
1,1-DICHLOROETHYLENE	µg/L	7	**0.46** J	0.5 U	**360** J	**0.11** J	**8.3** J	**600** J	**230** J	**0.2** J	13 U	0.5 U	0.5 UJ	0.5 U
1,2-DICHLOROETHANE	µg/L	0.12	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
ACETONE	µg/L	700	**3.7** J	**2.6** J	5 R	2.7 U	5 U	8,300 U	50 R	5 U	130 U	**2.2** J	5 U	**4.8** J
BENZENE	µg/L	0.35	0.5 U	0.5 U	**0.91** J	**0.26** J	**0.39** J	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	µg/L	0.18	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
CHLOROETHANE	µg/L	4.64	0.5 U	**0.45** J	0.5 U	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	µg/L	0.17	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**80** J	**1.5** J	**170,000**	**39**	**3,900** J	**41,000** J	**240,000**	**20**	**400**	**0.33** J	0.5 UJ	**1.1**
CHLORIDE)	µg/L	4.28	0.38 U	0.3 U	0.5 U	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	**0.22** J
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	830 U	5 U	0.5 U	13 U	0.5 U	0.5 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	**1.1**	0.5 U	**390** J	0.5 U	**16** J	**320** J	**660** J	0.5 U	13 U	0.5 U	0.5 UJ	0.5 U
TRICHLOROETHYLENE	µg/L	0.03	0.5 UJ	0.5 UJ	**4**	**0.74**	**310**	**17,000** J	**6.5** J	**3.6**	3.5 U	0.5 U	**0.12** J	**5.4** =
VINYL CHLORIDE	µg/L	0.02	**9** =	**2.9** =	**7,700**	**80**	**400**	**1,900** =	**30,000**	**57**	**120**	**0.3** J	0.5 U	0.5 U

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-2

February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-510D	MW-510S	MW-511D	MW-511S	MW-512D	MW-512S	MW-513D	MW-513S	MW-514D	MW-514S	MW-515D	MW-516D
		Sample Date>>	2/22/2007	2/22/2007	2/21/2007	2/21/2007	2/21/2007	2/21/2007	2/20/2007	2/20/2007	2/21/2007	2/21/2007	2/22/2007	2/22/2007
Analyte	Units	Screening Level												
VOCs														
1,1-DICHLOROETHYLENE	µg/L	7	0.5 UJ	0.5 UJ	2.5 U	13 U	**4.2**	**13** J	0.5 UJ	0.5 UJ	**4.4**	**34** J	13 U	25
1,2-DICHLOROETHANE	µg/L	0.12	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130 U	13 U	25
1,4-DICHLOROBENZENE	µg/L	0.5	0.5 U	0.5 U	2.5 U	13 U	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	130 U	13 U	25
ACETONE	µg/L	700	5 U	5 U	**11** J	130 U	**3.9** J	5 U	5 U	5 U	**4.4** J	**950** J	130 U	250
BENZENE	µg/L	0.35	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	130 U	**290** =	**580**
CHLORODIBROMOMETHANE	µg/L	0.18	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130 U	13 U	25
CHLOROETHANE	µg/L	4.64	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130 U	13 U	25
CHLOROFORM	µg/L	0.17	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130 U	13 U	25
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**0.72** J	**1.6** J	**8.9**	**130**	**910**	**2,000** J	**0.7** J	**2.8** J	**2,300** J	**2,600**	13 U	25
CHLORIDE)	µg/L	4.28	0.5 U	0.5 U	2.5 U	13 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	130 U	**4.3** J	**5.9**
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	0.5 U	0.5 U	2.5 U	13 U	0.5 U	**0.15** J	0.5 U	0.5 U	0.5 U	130 U	13 U	25
TRANS-1,2-DICHLOROETHENE	µg/L	100	0.5 UJ	0.5 UJ	2.5 U	**3** J	**2.4**	**17** J	0.5 UJ	0.5 UJ	**19** J	130 U	13 U	25
TRICHLOROETHYLENE	µg/L	0.03	**0.12** J	**1**	**34** =	**300** =	**0.13** J	**950**	**1.1** =	0.5 U	**500**	**1,200** =	13 U	25
VINYL CHLORIDE	µg/L	0.02	**0.31** J	**5.1**	**51**	13 U	**5,000**	**29** J	**0.45** J	**0.11** J	**1,700**	**1,800**	13 U	25

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-2
February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

		Location>>		MW-517S	MW-518D	MW-518S	MW-519D	MW-519S	MW-520D	MW-520S	MW-521D	MW-521S	MW-522D	MW-522S
		Sample Date>>		2/26/2007	2/22/2007	2/22/2007	2/22/2007	2/22/2007	2/23/2007	2/23/2007	2/26/2007	2/26/2007	2/22/2007	2/22/2007
Analyte	Units	Screening Level												
VOCs														
1,1-DICHLOROETHYLENE	µg/L	7	U	0.5 U	500 UJ	6.3 UJ	0.95 U	13 UJ	**230** J	**0.62** J	**440**	**0.26** J	830 U	4.2 U
1,2-DICHLOROETHANE	µg/L	0.12	U	0.5 U	500 U	6.3 U	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
1,4-DICHLOROBENZENE	µg/L	0.5	U	**0.89**	500 U	6.3 U	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
ACETONE	µg/L	700	U	5 U	**4,000** J	63 U	9.5 U	130 U	5 R	5 U	50 UJ	5 U	8,300 U	42 U
BENZENE	µg/L	0.35	=	0.5 U	500 U	6.3 U	0.95 U	13 U	**0.64**	0.5 U	5 U	0.5 U	830 U	4.2 U
CHLORODIBROMOMETHANE	µg/L	0.18	U	0.5 U	500 U	6.3 U	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
CHLOROETHANE	µg/L	4.64	U	0.5 U	500 U	6.3 U	**11** =	**230** =	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
CHLOROFORM	µg/L	0.17	U	0.5 U	500 U	6.3 U	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	U	**0.49** J	**11,000** J	**110** J	**12** =	**7.7** J	**84,000**	**8.8**	**8,500**	**16**	**9,300** =	**58** =
CHLORIDE)	µg/L	4.28	J	0.5 U	**160** J	**2.9** J	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	U	0.5 U	500 U	6.3 U	0.95 U	13 U	0.5 U	0.5 U	5 U	0.5 U	830 U	4.2 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	U	0.5 U	500 UJ	6.3 UJ	0.95 U	13 UJ	**370** J	**0.67** J	**32** J	0.5 U	830 U	4.2 U
TRICHLOROETHYLENE	µg/L	0.03	UJ	**1**	640 U	6.3 U	**16** =	13 U	**44,000**	**3.7** J	**1,100**	0.5 U	**23,000** =	**3** J
VINYL CHLORIDE	µg/L	0.02	U	**0.99**	**3,200**	**150**	**0.98**	**5.5** J	**3,700** J	**71**	**3,100**	**26**	**200** J	**92** =

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J = Value is estimated.
R = Result was rejected.
U = The analyte was not detected.
"---" indicates no limit identified

TABLE 2-2
February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

Analyte	Units	Location>> Sample Date>> Screening Level	MW-523D 2/21/2007	MW-523S 2/21/2007	MW-524S 2/21/2007	MW-525D 2/21/2007	MW-525S 2/21/2007	MW-526D 2/19/2007	MW-526S 2/21/2007	MW-527D 2/21/2007	MW-527S 2/22/2007	MW-528D 2/21/2007	MW-528S 2/21/2007	MW-529D 2/23/2007
VOCs														
1,1-DICHLOROETHYLENE	µg/L	7	2,500 UJ	13 U	**16** J	**580** J	63 U	**0.56**	**12** J	630 U	63 U	**9.8** J	**0.35** J	**3.7**
1,2-DICHLOROETHANE	µg/L	0.12	2,500 U	13 U	25 U	1.3 U	63 U	0.5 U	0.5 U	630 U	63 U	16 U	1.6 U	0.5
1,4-DICHLOROBENZENE	µg/L	0.5	2,500 U	13 U	25 U	1.3 U	63 U	0.5 U	0.5 U	630 U	63 U	16 U	1.6 U	0.5
ACETONE	µg/L	700	25,000 U	130 U	250 U	**5.7** J	630 U	**4.5** J	**4.6** J	6,300 U	630 U	160 U	16 U	5
BENZENE	µg/L	0.35	2,500 U	13 U	25 U	**0.69** J	63 U	0.5 U	**0.31** J	630 U	63 U	16 U	1.6 U	0.5
CHLORODIBROMOMETHANE	µg/L	0.18	2,500 U	13 U	25 U	1.3 U	63 U	0.5 U	0.5 U	630 U	63 U	16 U	1.6 U	0.5
CHLOROETHANE	µg/L	4.64	2,500 U	13 U	25 U	1.3 U	63 U	0.5 U	**0.33** J	630 U	63 U	16 U	1.6 U	0.5
CHLOROFORM	µg/L	0.17	2,500 U	13 U	25 U	**0.43** J	63 U	0.73 U	0.5 U	630 U	63 U	16 U	1.6 U	**0.4**
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**70,000**	**14**	**2,800**	**5,000**	**520**	**210** J	**2,200** J	**8,000** J	**540** =	**380**	**12**	**1,700**
CHLORIDE)	µg/L	4.28	2,500 U	13 U	25 U	1.3 U	63 U	0.5 U	0.5 U	630 U	63 U	16 U	1.6 U	**0.21**
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	2,500 U	13 U	25 U	**0.69** J	63 U	0.5 U	0.5 U	630 U	63 U	16 U	1.6 U	0.5
TRANS-1,2-DICHLOROETHENE	µg/L	100	2,500 U	13 U	**34**	**70** J	63 U	**2.1**	**21** J	630 U	63 U	16 U	1.6 U	**4.2**
TRICHLOROETHYLENE	µg/L	0.03	**210,000**	**170** =	**2,300**	**78,000**	**850** =	**29**	**1,300**	630 UJ	**730** J	**310** J	**22** =	**99**
VINYL CHLORIDE	µg/L	0.02	**570** J	13 U	**34**	**790** J	63 U	**310**	**41** J	**4,300** =	**490** =	**370**	**37**	**1,500**

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J = Value is estimated.
R = Result was rejected.
U = The analyte was not detected.
"---" indicates no limit identified

TABLE 2-2

February 2007 - Summary of VOCs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>		MW-529S	W-003	W-005	W-006	W-007	W-008	W-009	W-010	W-012
		Sample Date>>		2/23/2007	2/23/2007	2/19/2007	2/20/2007	2/19/2007	2/20/2007	2/19/2007	2/19/2007	2/19/2007
Analyte	Units	Screening Level										
VOCs												
1,1-DICHLOROETHYLENE	µg/L	7		**5.1**	0.5 U	0.5 U	**9.7** J	0.5 U	0.5 UJ	**0.45** J	8.4 U	0.5 U
1,2-DICHLOROETHANE	µg/L	0.12	U	0.5 U	0.5 U	0.5 U	**0.21** J	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	0.5	U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
ACETONE	µg/L	700	UJ	5 UJ	5 U	5 U	5 U	5 U	5 U	3.3 U	84 U	5 U
BENZENE	µg/L	0.35	U	**0.93**	0.5 U	0.5 U	**0.11** J	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
CHLORODIBROMOMETHANE	µg/L	0.18	U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
CHLOROETHANE	µg/L	4.64	U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.19** J	0.5 U	8.4 U	0.5 U
CHLOROFORM	µg/L	0.17	J	**0.92**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61		**2,000**	**4**	**1.8** =	**3,400** J	**0.22** J	**2.5** J	**66**	**180** J	**12**
CHLORIDE)	µg/L	4.28	J	**0.47** J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
TETRACHLOROETHYLENE(PCE)	µg/L	0.1	U	**0.23** J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.4 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100		**12**	**0.26** J	**0.44** J	**9.5** J	0.5 U	0.5 UJ	**0.17** J	8.4 U	0.5 U
TRICHLOROETHYLENE	µg/L	0.03		**830**	0.5 U	0.5 UJ	0.5 UJ	0.5 U	0.5 U	0.5 U	15 UJ	0.5 U
VINYL CHLORIDE	µg/L	0.02		**850**	**2.6**	**0.48** J	**1,000**	**0.13** J	**20**	**130**	8.4 U	**45**

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-3

February 2007 - Summary of PCBs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-517S
		Sample Date>>	3/22/2007
Analyte	Units	Screening Level	
PCBs			
PCB-1248 (AROCHLOR 1248)	µg/L	0.5	**100** J
PCB-1260 (AROCHLOR 1260)	µg/L	---	**9.3** J

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-4

February 2007 - Summary of Metals Exceeding Groundwater Remediation Objectives

OMC Plant 2

Analyte	Units	Screening Level	MW-011S	MW-014S	MW-015S	MW-502D	MW-502S	MW-503D	MW-504S	MW-505D	MW-505S	MW-506D	MW-516S	MW-518D	MW-518S	MW-520D	MW-520S	MW-521D	MW-521S
		Sample Date>>	2/23/2007	2/23/2007	2/22/2007	2/20/2007	2/20/2007	2/26/2007	2/19/2007	2/22/2007	2/22/2007	2/26/2007	2/22/2007	2/22/2007	2/22/2007	2/23/2007	2/23/2007	2/26/2007	2/26/2007
Dissolved Metals (Filtered)																			
IRON	µg/L	5,000	**2,570**	**2,260**	**59.6**	**15,700**	**5,810**	**51,500**	**1,290**	**5,300**	**11,500**	**7,770**	**5,800**	**5,180**	**6,330**	**6,690**	**2390**	**4,620**	**2,090**
MANGANESE	µg/L	150	**350**	**253**	**263**	**224**	**212**	**845**	**1,010**	**89.3**	**352**	**113**	**1,170**	**323**	**314**	**149**	**179**	**151**	**185**

Analyte	Units	Screening Level	MW-506S	MW-507S	MW-508S	MW-510S	MW-511S	MW-512S	MW-513S	MW-514D	MW-514S	MW-515S	MW-526S	MW-527D	MW-528D	MW-528S	MW-529D	MW-529S	W-001
		Sample Date>>	2/26/2007	2/21/2007	2/20/2007	2/22/2007	2/21/2007	2/21/2007	2/20/2007	2/21/2007	2/21/2007	2/22/2007	2/21/2007	2/21/2007	2/21/2007	2/21/2007	2/23/2007	2/23/2007	2/26/2007
Dissolved Metals (Filtered)																			
IRON	µg/L	5,000	**3,110** J	**4,530**	**3,200**	**134**	10 U	**79.8**	**1,680**	**7,600**	10 U	**5,750**	**2,560**	**8,750**	**#####**	**26.5** J	**4,180**	10 U	**4,560**
MANGANESE	µg/L	150	**281** J	**315**	**245**	**231**	**535**	**640**	**570**	**115**	**387**	**508**	**195**	**350**	**261**	**974**	**337**	**404**	**160**

Notes:

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

TABLE 2-4

February 2007 - Summary of Metals Exceeding Groundwater Remediati

OMC Plant 2

		Location>>	MW-522D	MW-523D	MW-525D	MW-527S
		Sample Date>>	2/22/2007	2/21/2007	2/21/2007	2/22/2007
Analyte	Units	Screening Level				
Dissolved Metals (Filtered)						
IRON	µg/L	5,000	**5,780**	**5,380**	**1,270**	10 U
MANGANESE	µg/L	150	**122**	**301**	**293**	**396**

		Location>>	W-002	W-003	W-005	W-006	W-007	W-009	W-010	W-011	W-012	W-013
		Sample Date>>	2/26/2007	2/23/2007	2/19/2007	2/20/2007	2/19/2007	2/19/2007	2/19/2007	2/19/2007	2/19/2007	2/20/2007
Analyte	Units	Screening Level										
Dissolved Metals (Filtered)												
IRON	µg/L	5,000	**1,350**	**3,370**	**5,940**	**10,000**	**1,130**	**6,140**	**7,470**	**7,840**	**3,240**	**7,040**
MANGANESE	µg/L	150	**155**	**248**	**416**	**112**	**176**	**224**	**90.8**	**146**	**259**	**363**

Notes:

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

TABLE 2-5
September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

Analyte	Units	Location>> / Sample Date>> / Screening Level	MW-003D 9/7/2007	MW-003S 9/7/2007	MW-011D 9/5/2007	MW-011S 9/5/2007	MW-014D 9/11/2007	MW-014D 9/11/2007	MW-014S 9/11/2007	MW-015D 9/11/2007	MW-015D 9/11/2007	MW-015S 9/11/2007	MW-500D 9/10/2007
VOCs													
1,1,1-TRICHLOROETHANE	µg/L	200	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.99**	5 U
1,1-DICHLOROETHANE	µg/L	700	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.73**	5 U
1,1-DICHLOROETHYLENE	µg/L	7	10 U	0.5 U	40 U	**6.7**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.29 J**	5 U
1,2,4-TRICHLOROBENZENE	µg/L	7.16	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
1,4-DICHLOROBENZENE	µg/L	0.5	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
BENZENE	µg/L	0.35	**180**	0.5 U	40 U	5 U	**94**	**85**	0.5 U	0.5 U	0.5 U	0.5 U	**7.3**
CHLOROETHANE	µg/L	4.64	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
CHLOROMETHANE	µg/L	158	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	10 U	0.5 U	**230 J**	**630**	**0.67**	**0.63**	0.5 U	0.5 U	0.5 U	**18**	**1,700**
CIS-1,3-DICHLOROPROPENE	µg/L	---	10 U	0.5 U	**28 J**	5 UJ	0.5 J	0.5 U	0.5 UJ	0.5 J	0.5 UJ	0.5 U	5 J
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
M-DICHLOROBENZENE	µg/L	183	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
METHYLBENZENE	µg/L	723	**10**	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	**5.3 J**	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.51**	**4.5 J**
TRICHLOROETHYLENE	µg/L	0.03	10 U	0.5 U	40 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**29**	5 U
VINYL CHLORIDE	µg/L	0.02	10 U	0.5 U	**5,200**	**250**	**1.8**	**1.9**	0.5 U	0.5 U	0.5 U	**2.1**	**530**

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J Value is estimated.
R Result was rejected.
U The analyte was not detected.
"---" indicates no limit identified

TABLE 2-5
September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

		Location>>	MW-500S	MW-501D	MW-501S	MW-502D	MW-502D	MW-502S	MW-503D	MW-504D	MW-504D	MW-504S	MW-505D	MW-505S
		Sample Date>>	9/10/2007	9/10/2007	9/10/2007	9/10/2007	9/10/2007	9/10/2007	9/4/2007	9/7/2007	9/7/2007	9/7/2007	9/6/2007	9/6/2007
Analyte	Units	Screening Level												
VOCs														
1,1,1-TRICHLOROETHANE	µg/L	200	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.55**	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
1,1-DICHLOROETHANE	µg/L	700	0.5 U	**0.64**	**15**	**1.9**	**1.7**	**3.6**	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
1,1-DICHLOROETHYLENE	µg/L	7	0.5 U	0.5 U	0.5 U	**0.69**	**0.63**	0.5 U	50 U	0.5 U	0.5 U	**14 J**	**310 J**	0.5 U
1,2,4-TRICHLOROBENZENE	µg/L	7.16	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	0.5	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
BENZENE	µg/L	0.35	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.26 J**	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
CHLOROETHANE	µg/L	4.64	0.5 U	0.5 U	**8.4**	0.5 U	0.5 U	**0.91**	50 U	0.5 U	0.5 U	20 U	500 U	**4.9**
CHLOROMETHANE	µg/L	158	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**41**	**0.3 J**	**21**	**110**	**94**	**4.1**	**110,000 J**	**21**	**25**	**3,700**	**31,000**	0.5 U
CIS-1,3-DICHLOROPROPENE	µg/L	---	0.5 UJ	0.5 UJ	0.5 UJ	0.5 J	0.5 J	0.5 U	50 J	0.5 U	0.5 U	20 U	500 U	0.5 U
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
M-DICHLOROBENZENE	µg/L	183	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
METHYLBENZENE	µg/L	723	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	20 U	500 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	**0.28 J**	0.5 U	**0.91**	**1.9**	**1.7**	0.5 U	**250**	0.5 U	0.5 U	**16 J**	500 U	0.5 U
TRICHLOROETHYLENE	µg/L	0.03	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	**600**	**17,000**	0.5 U
VINYL CHLORIDE	µg/L	0.02	**59**	**17**	**8.9**	**11**	**11**	**4.4**	**16,000**	**41**	**53**	**610**	**2,900**	0.5 U

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J Value is estimated.
R Result was rejected.
U The analyte was not detected.
"---" indicates no limit identified

TABLE 2-5
September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

Analyte	Units	Location>> Sample Date>> Screening Level	MW-506D 9/6/2007	MW-506S 9/6/2007	MW-507D 9/4/2007	MW-507S 9/4/2007	MW-508D 9/11/2007	MW-508S 9/11/2007	MW-509D 9/11/2007	MW-509S 9/11/2007	MW-510D 9/7/2007	MW-510S 9/7/2007	MW-511D 9/7/2007	MW-511S 9/7/2007
VOCs														
1,1,1-TRICHLOROETHANE	µg/L	200	1,000 U	**0.43 J**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.48 J**	0.5 U	10
1,1-DICHLOROETHANE	µg/L	700	1,000 U	**0.53**	0.5 U	0.5 U	0.5 U	0.5 U	**0.27 J**	**0.56**	0.5 U	**0.34 J**	**0.26 J**	10
1,1-DICHLOROETHYLENE	µg/L	7	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**5.4**
1,2,4-TRICHLOROBENZENE	µg/L	7.16	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
1,4-DICHLOROBENZENE	µg/L	0.5	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
BENZENE	µg/L	0.35	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
CHLOROETHANE	µg/L	4.64	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
CHLOROMETHANE	µg/L	158	1,000 U	0.5 U	0.5 U	**0.27 J**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**120,000**	**10**	**360**	**0.32 J**	0.5 U	0.5 U	0.5 U	**1.4**	**0.7**	**2.1**	0.5 U	**370**
CIS-1,3-DICHLOROPROPENE	µg/L	---	1,000 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 J	0.5 U	10
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	**500 J**	0.5 U	0.5 U	**0.36 J**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
M-DICHLOROBENZENE	µg/L	183	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
METHYLBENZENE	µg/L	723	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	1,000 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
TRANS-1,2-DICHLOROETHENE	µg/L	100	**540 J**	0.5 U	**0.7**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	10
TRICHLOROETHYLENE	µg/L	0.03	1,000 U	**4.2**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	**0.98**	0.5 U	**3.2**	0.5 U	**1,900**
VINYL CHLORIDE	µg/L	0.02	**21,000**	**170**	**330**	**0.31 J**	**0.29 J**	0.5 U	0.5 U	0.5 U	**0.85**	**6.3**	0.5 U	10

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J Value is estimated.
R Result was rejected.
U The analyte was not detected.
"---" indicates no limit identified

TABLE 2-5
September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

		Location>>		MW-512D	MW-512S	MW-513D	MW-513S	MW-514D	MW-514S	MW-515D	MW-515S	MW-516D	MW-516D	MW-516S
		Sample Date>>		9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/11/2007	9/11/2007	9/7/2007	9/7/2007	9/7/2007
Analyte	Units	Screening Level												
VOCs														
1,1,1-TRICHLOROETHANE	µg/L	200	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 U	2 U	2 U	0.5 U
1,1-DICHLOROETHANE	µg/L	700	U	40 U	5 U	**0.33 J**	0.5 U	50 U	10 U	0.5 U	0.5 U	2 U	2 U	0.5 U
1,1-DICHLOROETHYLENE	µg/L	7	**J**	**120 J**	**6**	0.5 U	0.5 U	50 U	**5.7 J**	0.5 U	0.5 U	2 U	2 U	0.5 U
1,2,4-TRICHLOROBENZENE	µg/L	7.16	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 UJ	2 U	2 U	0.5 U
1,4-DICHLOROBENZENE	µg/L	0.5	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 UJ	2 U	2 U	0.5 U
BENZENE	µg/L	0.35	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	**170 J**	0.5 U	**460**	**450**	0.5 U
CHLOROETHANE	µg/L	4.64	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 U	2 U	2 U	0.5 U
CHLOROMETHANE	µg/L	158	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 U	2 U	2 U	0.5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61		**120,000 J**	**1,100**	0.73 U	0.5 U	**4,300**	**1,900**	0.5 U	0.5 U	2 U	2 U	**0.57 J**
CIS-1,3-DICHLOROPROPENE	µg/L	---	U	**29 J**	5 U	0.5 UJ	0.5 U	50 UJ	**6.6 J**	0.5 UJ	0.5 UJ	**1.5 J**	2 U	**0.38 J**
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	U	40 U	5 U	0.5 U	**0.26 J**	50 U	10 U	0.5 U	0.5 U	2.8 U	2.6 U	0.5 U
M-DICHLOROBENZENE	µg/L	183	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 UJ	2 U	2 U	0.5 U
METHYLBENZENE	µg/L	723	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 U	**7.9**	**8.3**	0.5 U
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	U	40 U	5 U	0.5 U	0.5 U	50 U	10 U	0.5 U	0.5 U	2 U	2 U	0.5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	U	**94 J**	**4.9 J**	0.5 U	0.5 U	50 U	**6.5 J**	0.5 U	0.5 U	2 U	2 U	0.5 U
TRICHLOROETHYLENE	µg/L	0.03		40 U	**860**	0.5 U	0.5 U	50 U	**890**	0.5 U	0.5 U	2 U	2 U	0.5 U
VINYL CHLORIDE	µg/L	0.02	U	**13,000**	**13**	**2.8**	0.5 U	**7,300**	**3,300**	0.5 U	0.5 U	2 U	2 U	**3.4**

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J Value is estimated.
R Result was rejected.
U The analyte was not detected.
"---" indicates no limit identified

TABLE 2-5

September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives

OMC Plant 2

Analyte	Units	Location>>	MW-517S	MW-518D	MW-518S	MW-519D	MW-519S	MW-520D	MW-520S	MW-521D	MW-521S	MW-522D	MW-522D
		Sample Date>>	9/5/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007
		Screening Level											
VOCs													
1,1,1-TRICHLOROETHANE	µg/L	200	0.5 U	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
1,1-DICHLOROETHANE	µg/L	700	**0.44 J**	100 U	**2.1**	0.5 U	**0.44 J**	400 U	20 U	20 U	**0.81 J**	400 U	200 U
1,1-DICHLOROETHYLENE	µg/L	7	0.5 U	100 U	**0.31 J**	0.5 U	0.5 U	**270 J**	**19 J**	**170**	0.5 U	400 U	**100 J**
1,2,4-TRICHLOROBENZENE	µg/L	7.16	**0.31 J**	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
1,4-DICHLOROBENZENE	µg/L	0.5	**1.1**	100 U	0.5 U	0.5 U	**0.39 J**	400 U	20 U	20 U	0.5 U	400 U	200 U
BENZENE	µg/L	0.35	0.5 U	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
CHLOROETHANE	µg/L	4.64	0.5 U	100 U	0.5 U	0.5 U	**610**	400 U	20 U	20 U	0.5 U	400 U	200 U
CHLOROMETHANE	µg/L	158	0.5 U	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	0.5 U	**9,000**	**47 J**	0.5 U	**1.2**	**60,000**	**220**	**6,300**	**3.7 J**	**25,000**	**20,000**
CIS-1,3-DICHLOROPROPENE	µg/L	---	0.5 U	100 U	0.5 UJ	0.5 U	**0.26 J**	400 U	20 U	20 U	0.5 U	400 U	200 U
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	0.5 U	100 U	0.5 U	0.5 U	0.65 U	600 U	20 U	20 U	0.5 U	400 U	200 U
M-DICHLOROBENZENE	µg/L	183	**0.67**	100 U	0.5 U	0.5 U	**0.3 J**	400 U	20 U	20 U	0.5 U	400 U	200 U
METHYLBENZENE	µg/L	723	0.5 U	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	0.5 U	100 U	0.5 U	0.5 U	0.5 U	400 U	20 U	20 U	0.5 U	400 U	200 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	0.5 U	100 U	0.5 U	0.5 U	0.5 U	**320 J**	20 U	**31**	0.5 U	400 U	**180 J**
TRICHLOROETHYLENE	µg/L	0.03	0.5 U	100 U	**1.1**	0.5 U	0.5 U	**31,000**	20 U	**1,300**	0.5 U	**100,000**	**81,000**
VINYL CHLORIDE	µg/L	0.02	**0.7**	**15,000**	**310 J**	0.5 U	**0.62**	**5,500**	**490**	**1,800**	**9.2 J**	**960**	**900**

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J Value is estimated.

R Result was rejected.

U The analyte was not detected.

"---" indicates no limit identified

TABLE 2-5
September 2007 Summary of VOCs Exceeding Groundwater Remediation Objectives
OMC Plant 2

Analyte	Units	Location>> Sample Date>> Screening Level	MW-522S 9/6/2007	MW-523D 9/4/2007	MW-523S 9/4/2007	MW-524S 9/4/2007	MW-524S 9/4/2007	MW-525D 9/4/2007	MW-525S 9/4/2007	MW-526D 9/4/2007	MW-526S 9/4/2007	MW-527D 9/5/2007
VOCs												
1,1,1-TRICHLOROETHANE	µg/L	200	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
1,1-DICHLOROETHANE	µg/L	700	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
1,1-DICHLOROETHYLENE	µg/L	7	5 U	**250 J**	0.5 U	0.5 U	0.5 U	**150 J**	0.5 U	0.5 U	2.5 U	5 U
1,2,4-TRICHLOROBENZENE	µg/L	7.16	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
1,4-DICHLOROBENZENE	µg/L	0.5	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
BENZENE	µg/L	0.35	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
CHLOROETHANE	µg/L	4.64	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
CHLOROMETHANE	µg/L	158	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
CIS-1,2-DICHLOROETHYLENE	µg/L	61	**300**	**73,000**	**18**	**110**	**110**	**5,900**	**55**	**11 J**	**340**	**120**
CIS-1,3-DICHLOROPROPENE	µg/L	---	5 U	500 UJ	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 UJ
DICHLOROMETHANE (METHELYNE CHLORIDE)	µg/L	4.28	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
M-DICHLOROBENZENE	µg/L	183	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
METHYLBENZENE	µg/L	723	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
O-XYLENE (1,2-DIMETHYLBENZENE)	µg/L	206	5 U	500 U	0.5 U	0.5 U	0.5 U	50 U	0.5 U	0.5 U	2.5 U	5 U
TRANS-1,2-DICHLOROETHENE	µg/L	100	5 U	**310 J**	0.5 U	**1.8**	**1.7**	**56 J**	**1.3**	0.5 U	**4.7**	5 U
TRICHLOROETHYLENE	µg/L	0.03	5 U	**150,000**	**38**	**100**	**110**	**26,000**	**150**	0.5 U	**150**	5 U
VINYL CHLORIDE	µg/L	0.02	**1,500**	**470 J**	0.5 U	0.5 U	0.5 U	**1,400**	0.5 U	**460**	**11**	**1,900**

Units are in micrograms per liter (µg/L).
Shaded results indicate an exceedance of remedial standard.
Bolded results indicate the analyte was detected.
J Value is estimated.
R Result was rejected.
U The analyte was not detected.
"---" indicates no limit identified

TABLE 2-6

September 2007 Summary of PCBs Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-517S
		Sample Date>>	9/12/2007
Analyte	Units	Screening Level	
PCBs			
PCB-1016 (AROCHLOR 1016)	µg/L	0.5	90 J

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

"---" indicates no limit identified

TABLE 2-7

September 2007 Summary of Metals Exceeding Groundwater Remediation Objectives

OMC Plant 2

		Location>>	MW-003D	MW-003S	MW-011D	MW-011S	MW-014D	MW-014D	MW-014S	MW-015D	MW-015D	MW-015S	MW-500D	MW-500S	MW-501D	MW-501S	MW-502D	MW-502D
		Sample Date>>	9/7/2007	9/7/2007	9/5/2007	9/5/2007	9/11/2007	9/11/2007	9/11/2007	9/11/2007	9/11/2007	9/11/2007	9/10/2007	9/10/2007	9/10/2007	9/10/2007	9/10/2007	9/10/2007
Analyte	Units	Screening Level																
Dissolved Metals (Filtered)																		
IRON	µg/L	5,000	**2,310**	**1,840**	**5,470 J**	**1,350 J**	**2,040**	**2,290**	**5,010**	**3,550**	**3,350**	**331**	**11,100**	**304**	**3,790**	**3,070**	**15,800**	**15,800**
MANGANESE	µg/L	150	55 UB	141 UB	37.2 UB	**365**	**42**	**47.9**	**457**	**47.8**	**44.5**	**372**	**161**	**310**	**58.8**	**218**	**219**	**226**

		Location>>	MW-516S	MW-517S	MW-518D	MW-518S	MW-519D	MW-519S	MW-520D	MW-520S	MW-521D	MW-521S	MW-522D	MW-522D	MW-522S	MW-523D	MW-523S	MW-524S
		Sample Date>>	9/12/2007	9/12/2007	9/12/2007	9/12/2007	9/6/2007	9/6/2007	9/12/2007	9/12/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/6/2007	9/12/2007	9/12/2007	9/12/2007
Analyte	Units	Screening Level																
Dissolved Metals (Filtered)																		
IRON	µg/L	5,000	**2,230**	**694**	**22,800**	**8,400**	**6,100**	**2,340**	**13,000**	**3,500**	**6,060**	**2,400**	**7,460 J**	**6,420**	**2,580**	**4,620**	**100**	10 U
MANGANESE	µg/L	150	**705**	**211**	**171**	**497**	105 UB	190 UB	**72**	**160**	71.9 UB	**185**	67.2 UB	77.6 UB	**137**	**366**	**4.4**	0.4 U

Notes:

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

TABLE 2-7

September 2007 Summary of Metals Exceeding Groundwater Remediat

OMC Plant 2

		Location>>	MW-502S	MW-503D	MW-504D	MW-504D	MW-504S	MW-505D	MW-505S	MW-506D	MW-506S	MW-507D	MW-507S
		Sample Date>>	9/10/2007	9/4/2007	9/13/2007	9/13/2007	9/13/2007	9/12/2007	9/12/2007	9/6/2007	9/6/2007	9/4/2007	9/4/2007
Analyte	Units	Screening Level											
Dissolved Metals (Filtered)													
IRON	µg/L	5,000	**4,580**	**52,000**	**4,640**	**4,770**	**1,500**	**9,800**	**8,400**	**11,700 J**	**23,000**	**3,580**	**2,270**
MANGANESE	µg/L	150	**210**	**804**	**62.3**	**66.9**	**479**	**83**	**340**	90.4 UB	**180**	117 UB	**188**

		Location>>	MW-525D	MW-525S	MW-526D	MW-526S	MW-527D	MW-527S	MW-527S	MW-528D	MW-528S	MW-529D	MW-529S
		Sample Date>>	9/4/2007	9/4/2007	9/4/2007	9/4/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007	9/5/2007
Analyte	Units	Screening Level											
Dissolved Metals (Filtered)													
IRON	µg/L	5,000	**3,650**	10 U	**4,810**	10 U	**9,960**	10 U	10 U	**13,000**	**240 J**	**4,580**	10 U
MANGANESE	µg/L	150	**380**	10.4 UB	**127**	68.2 UB	**262**	**644**	**567**	**219 J**	**1,030**	**155**	**405**

Notes:

Units are in micrograms per liter (µg/L).

Shaded results indicate an exceedance of remedial standard.

Bolded results indicate the analyte was detected.

J = Value is estimated.

R = Result was rejected.

U = The analyte was not detected.

TABLE 3-1

February 2007 - Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 2

OMC Plant 2

		Non-Elevated VOC Area[1]			Highest VOC Area in Shallow[2]				Highest VOC Area in Deep[3]			
Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Frequency of Detection	Range in Concentration (mg/L)		Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range	Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	12/12	0.18	9.41	6/6	0.13	8.46	2	5/5	0.24	2.00	2
Nitrate (mg/L)	< 1 mg/L	6/12	NA	0.39	5/6	NA	1.8	4	NA	0.1	0.81	5
Iron II (mg/L)	> 1 mg/L	12/12	0.01	10	3/6	ND	2.56	2	5/5	ND	5.38	4
Sulfate (mg/L)	< 20 mg/L	12/12	82	280	6/6	31	100	0	5/5	10	200	1
Sulfide (mg/L)	> 1 mg/L	1/12	NA	1.4	0/6	NA	NA	NA	0/5	NA	NA	NA
Methane (mg/L)	> 0.5 mg/L	12/12	0.00027	1.9	6/6	0.0022	0.11	0	5/5	0.16	1.5	1
Oxidation Reduction Potential[4] (mV)	< -100 mV	12/12	-286.2	142.9	6/6	-125.0	160.0	0	5/5	-142.5	-69.3	2
pH	5 < pH < 9	12/12	6.5	8.15	6/6	6.81	7.57	6	5/5	7.16	7.40	5
TOC (mg/L)	> 20 mg/L	12/12	1	21	4/6	0.79	9	0	4/5	3.3	8.8	0
Temperature (degrees Celsius)	> 20C	12/12	2.49	11.17	6/6	4.86	7.74	0	5/5	9.54	12.05	0
Alkalinity (mg/L)	> 2x background	12/12	97	690	6/6	280	470	0	5/5	310	450	0
Chloride (mg/L)	> 2x background	12/12	2.8	1800	6/6	3.2	330	0	5/5	55	300	0
BTEX (mg/L)	> 0.1 mg/L	3/12	NA	0.21	2/6	NA	0.0004	0	2/5	NA	0.0007	0
Tetrachloroethene (mg/L)	NA	0/12	NA	NA	0/6	NA	NA	NA	1/5	NA	0.0007	NA
Trichloroethene (mg/L)	NA	2/12	NA	0.0065	6/6	0.17	2.3	NA	4/5	ND	210	NA
cis-1,2-dichloroethene (mg/L)	NA	9/12	ND	240	6/6	0.014	3.9	NA	5/5	0.0089	70	NA
trans-1,2-dichloroethene (mg/L)	NA	3/12	ND	0.66	4/6	ND	0.034	NA	2/5	ND	0.07	NA
Vinyl chloride (mg/L)	NA	9/12	ND	30	3/6	ND	0.4	NA	5/5	0.051	0.79	NA
1,1,1-trichloroethane (mg/L)	NA	1/12	ND	0.0003	1/6	ND	0.0005	NA	0/5	NA	NA	NA
1,1-dichloroethane (mg/L)	NA	3/12	ND	0.23	3/6	ND	0.016	NA	3/5	ND	0.58	NA
Chloroethane (mg/L)	NA	0/12	NA	NA	1/6	ND	0.0003	NA	0/5	NA	NA	NA
Ethene (mg/L)	> 0.01 mg/L	6/12	ND	0.29	2/6	ND	0.33	1	4/5	ND	0.12	3
Ethane (mg/L)	> 0.01 mg/L	2/12	ND	0.0052	2/6	ND	0.25	1	4/5	ND	0.0041	0

[1]Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-500S, MW-506S, MW-507S, MW-508S, MW-3S.

[1]Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-500D, MW-506D, MW-507D, MW-508D, W-6, W-7, MW-3D.

[2] Results from monitoring wells MW-504S, MW-511S, MW-523S, MW-524S, MW-525S, MW-526S

[3] Results from monitoring wells MW-504D, MW-511D, MW-523D, MW-525D, MW-526D

[4]See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-2
February 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 2
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	0	0
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	-3	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	2
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	0	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	0	0
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0	0
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	0	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	2	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	2	2
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**6**	**14**
			INTERPRETATION (6 to 14):	**LIMITED EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 3-3

February 2007 - Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 4

OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Non-Elevated VOC Area[1]			Highest VOC Area in Shallow[2]				Highest VOC Area in Deep[3]			
		Frequency of Detection	Range in Concentration (mg/L)		Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range	Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	10/10	0.16	9.41	6/6	0.21	1.49	2	6/6	0.22	2.00	5
Nitrate (mg/L)	< 1 mg/L	10/10	ND	0.39	5/6	ND	0.55	5	1/6	ND	0.15	1
Iron II (mg/L)	> 1 mg/L	10/10	0.0131	5.8	3/6	ND	2.57	1	6/6	3.95	13.5	6
Sulfate (mg/L)	< 20 mg/L	9/10	ND	340	6/6	23	88	0	6/6	110	1200	0
Sulfide (mg/L)	> 1 mg/L	2/10	ND	1.4	0/6	NA	NA	NA	0/6	NA	NA	NA
Methane (mg/L)	> 0.5 mg/L	10/10	0.0003	11	6/6	0.0034	1.1	3	6/6	0.39	1.7	3
Oxidation Reduction Potential[4] (mV)	< -100 mV	10/10	-286.2	142.9	6/6	-111.9	218.6	1	6/6	-136.5	114.6	3
pH	5 < pH < 9	10/10	6.7	8.15	6/6	6.9	7.28	6	6/6	6.79	7.26	6
TOC (mg/L)	> 20 mg/L	10/10	1.3	55	5/6	ND	5.4	0	6/6	3.2	18	0
Temperature (degrees Celsius)	> 20C	10/10	4.11	10.82	6/6	4.65	7.01	0	6/6	8.71	12.84	0
Alkalinity (mg/L)	> 2x background	10/10	280	1000	6/6	340	490	0	6/6	370	480	0
Chloride (mg/L)	> 2x background	10/10	2.8	2100	6/6	12	130	0	6/6	140	270	0
BTEX (mg/L)	> 0.1 mg/L	4/10	ND	1.74	1/6	ND	0.0009	0	0/6	NA	NA	NA
Tetrachloroethene (mg/L)	NA	0/10	NA	NA	2/6	ND	0.0002	NA	0/6	NA	NA	NA
Trichloroethene (mg/L)	NA	1/10	ND	0.0011	6/6	0.022	1.2	NA	5/6	ND	0.5	NA
cis-1,2-dichloroethene (mg/L)	NA	5/10	ND	0.4	6/6	0.012	2.6	NA	6/6	0.0047	8	NA
trans-1,2-dichloroethene (mg/L)	NA	1/10	ND	0.0002	3/6	0.0076	0.017	NA	3/6	ND	0.019	NA
Vinyl chloride (mg/L)	NA	5/10	ND	0.12	6/6	0.029	1.8	NA	6/6	0.12	5	NA
1,1,1-trichloroethane (mg/L)	NA	0/10	NA	NA	2/6	ND	0.0013	NA	0/6	NA	NA	NA
1,1-dichloroethane (mg/L)	NA	1/10	ND	0.0003	4/6	ND	0.017	NA	2/6	ND	0.0012	NA
Chloroethane (mg/L)	NA	0/10	NA	NA	0/6	NA	NA	NA	0/6	NA	NA	NA
Ethene (mg/L)	> 0.01 mg/L	2/10	ND	0.0017	3/6	ND	0.014	1	6/6	0.14	0.36	6
Ethane (mg/L)	> 0.01 mg/L	3/10	ND	0.002	5/6	ND	1.2	4	6/6	0.0005	0.022	2

[1] Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-507S, MW-513S, MW-515S, MW-516S, MW-3S

[1] Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-507D, MW-513D, MW-515D, MW-516D, MW-3D

[2] Results from monitoring wells MW-11S, MW-512S, MW-514S, MW-527S, MW-528S, MW-529S

[3] Results from monitoring wells MW-11D, MW-512D, MW-514D, MW-527D, MW-528D, MW-529D

[4] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-4
February 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 4
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	0	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	0
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	0	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	3	3
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0	2
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	0	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	2	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	2	0
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	3
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**14**	**21**
			INTERPRETATION (6 to 14):	**LIMITED EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	
			INTERPRETATION (>20):	**STRONG EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED SOLVENTS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 3-5

February 2007 - Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 5

OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Non-Elevated VOC Area[1] Frequency of Detection	Non-Elevated VOC Area[1] Range in Concentration (mg/L)		Highest VOC Area in Shallow[2] Frequency of Detection	Highest VOC Area in Shallow[2] Range in Concentration (mg/L)		Highest VOC Area in Shallow[2] Number of Samples in Preferred Range	Highest VOC Area in Deep[3] Frequency of Detection	Highest VOC Area in Deep[3] Range in Concentration (mg/L)		Highest VOC Area in Deep[3] Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	10/10	0.17	4.7	6/6	0.33	4.03	4	7/7	0.19	6.94	4
Nitrate (mg/L)	< 1 mg/L	3/10	ND	0.26	0/6	NA	NA	NA	1/7	ND	0.17	0
Iron II (mg/L)	> 1 mg/L	10/10	1.68	15.7	6/6	1.73	11.5	6	7/7	4.62	51.5	7
Sulfate (mg/L)	< 20 mg/L	9/10	ND	430	6/6	3	120	2	7/7	64	1000	0
Sulfide (mg/L)	> 1 mg/L	0/10	NA	NA	0/6	NA	NA	NA	0/7	NA	NA	NA
Methane (mg/L)	> 0.5 mg/L	9/10	ND	4.6	6/6	0.0008	3.9	3	7/7	0.41	1.6	6
Oxidation Reduction Potential[4] (mV)	< -100 mV	10/10	-142.5	56.6	6/6	77.9	-119.1	2	7/7	-94.2	19.8	0
pH	5 < pH < 9	10/10	6.65	7.86	6/6	6.8	7.46	6	7/7	6.65	7.22	7
TOC (mg/L)	> 20 mg/L	10/10	0.85	7.3	6/6	ND	5.6	0	7/7	ND	10	0
Temperature (degrees Celsius)	> 20C	10/10	3.96	11.34	6/6	7.91	11.60	0	7/7	8.62	12.97	0
Alkalinity (mg/L)	> 2x background	10/10	280	470	6/6	220	450	0	7/7	350	420	0
Chloride (mg/L)	> 2x background	10/10	63	290	6/6	100	310	0	7/7	240	440	0
BTEX (mg/L)	> 0.1 mg/L	0/10	NA	NA	0/6	NA	NA	NA	2/7	ND	0.0124	0
Tetrachloroethene (mg/L)	NA	0/10	NA	NA	0/6	NA	NA	NA[7]	0/7	NA	NA	NA[7]
Trichloroethene (mg/L)	NA	2/10	0.0011	0.016	3/6	0.003	0.0037	NA[7]	6/7	0.004	44	NA[7]
cis-1,2-dichloroethene (mg/L)	NA	9/10	ND	0.18	5/6	ND	0.11	NA[7]	7/7	8.5	240	NA[7]
trans-1,2-dichloroethene (mg/L)	NA	2/10	ND	0.0011	1/6	ND	0.0007	NA[7]	5/7	ND	0.66	NA[7]
Vinyl chloride (mg/L)	NA	8/10	ND	0.13	5/6	ND	0.15	NA[7]	7/7	0.2	30	NA[7]
1,1,1-trichloroethane (mg/L)	NA	2/10	ND	0.0002	1/6	ND	0.0003	NA[7]	0/7	NA	NA	NA[7]
1,1-dichloroethane (mg/L)	NA	7/10	ND	0.019	5/6	ND	0.0025	NA[7]	2/7	ND	0.017	NA[7]
Chloroethane (mg/L)	NA	7/10	ND	0.023	1/6	ND	0.0022	NA[7]	0/7	ND	ND	NA[7]
Ethene (mg/L)	> 0.01 mg/L	8/10	ND	0.0065	6/6	ND	0.022	2	7/7	0.059	0.69	7
Ethane (mg/L)	> 0.01 mg/L	6/10	ND	0.069	6/6	ND	0.36	2	7/7	0.0008	0.056	1

[1]Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-502S, MW-513S, MW-519S

[1]Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-502D, MW-513D, MW-519D, W-9, W-10, W-11, W-12

[2] Results from monitoring wells MW-505S, MW-506S, MW-518S, MW-520S, MW-521S, MW-522S

[3] Results from monitoring wells MW-503D, MW-505D, MW-506D, MW-518D, MW-520D, MW-521D, MW-522D

[4]See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-6
February 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 5
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	3	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	3	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	3	3
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0	0
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	0	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	2	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	2	0
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	3
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**18**	**19**
			INTERPRETATION (15 to 20):	**ADEQUATE EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 3-7

September 2007 - Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 2

OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Non-Elevated VOC Area[1] Frequency of Detection	Non-Elevated VOC Area[1] Range in Concentration (mg/L)		Highest VOC Area in Shallow[2] Frequency of Detection	Highest VOC Area in Shallow[2] Range in Concentration (mg/L)		Highest VOC Area in Shallow[2] Number of Samples in Preferred Range	Highest VOC Area in Deep[3] Frequency of Detection	Highest VOC Area in Deep[3] Range in Concentration (mg/L)		Highest VOC Area in Deep[3] Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	12/12	-0.7	4.9	6/6	0.33	6.49	1	5/5	0.12	19.10	3
Nitrate (mg/L)	< 1 mg/L	2/12	ND	0.31	5/6	ND	4.4	4	5/5	ND	0.32	5
Iron II (mg/L)	> 1 mg/L	12/12	0.304	23	2/6	ND	1.5	1	5/5	3.65	4.81	5
Sulfate (mg/L)	< 20 mg/L	12/12	1.4	710	6/6	35	120	0	5/5	3.7	200	1
Sulfide (mg/L)	> 1 mg/L	1/12	ND	1.4	0/6	ND	ND	0	0/5	ND	ND	0
Methane (mg/L)	> 0.5 mg/L	12/12	0.0081	6.3	5/6	ND	0.7	0	5/5	0.057	1.6	1
Oxidation Reduction Potential[4] (mV)	< -100 mV	12/12	-80	-164.4	6/6	-37	393.5	0	5/5	-90.1	-151.2	4
pH	5 < pH < 9	12/12	6.62	7.69	6/6	6.28	7.60	6	5/5	6.72	7.29	5
TOC (mg/L)	> 20 mg/L	12/12	2.7	23	6/6	0.92	7.7	0	5/5	2.9	8.3	0
Temperature (degrees Celsius)	> 20C	12/12	14.72	23.28	6/6	16.85	23.78	4	5/5	13.72	17.71	0
Alkalinity (mg/L)	> 2x background	12/12	250	670	6/6	230	430	0	5/5	290	440	0
Chloride (mg/L)	> 2x background	12/12	2.4	2000	6/6	5.2	71	0	5/5	89	460	0
BTEX (mg/L)	> 0.1 mg/L	12/12	ND	0.01	0/6	ND	ND	0	0/5	ND	ND	0
Tetrachloroethene (mg/L)	NA	0/12	ND	ND	0/6	ND	ND	NA	0/5	ND	ND	NA
Trichloroethene (mg/L)	NA	1/12	ND	0.0042	6/6	0.038	1.9	NA	2/5	ND	150	NA
cis-1,2-dichloroethene (mg/L)	NA	7/12	ND	120	6/6	0.018	3.7	NA	4/5	ND	73	NA
trans-1,2-dichloroethene (mg/L)	NA	4/12	ND	0.54	4/6	ND	0.016	NA	2/5	ND	0.31	NA
Vinyl chloride (mg/L)	NA	9/12	ND	21	2/6	ND	0.61	NA	4/5	ND	1.4	NA
1,1,1-trichloroethane (mg/L)	NA	1/12	ND	0.00043	0/6	ND	ND	NA	0/5	ND	ND	NA
1,1-dichloroethane (mg/L)	NA	3/12	ND	0.15	0/6	ND	ND	NA	1/5	ND	0.00026	NA
Chloroethane (mg/L)	NA	0/12	ND	ND	0/6	ND	ND	NA	0/5	ND	ND	NA
Ethene (mg/L)	> 0.01 mg/L	10/12	ND	0.13	1/6	ND	0.00096	0	5/5	0.0034	0.32	3
Ethane (mg/L)	> 0.01 mg/L	3/12	ND	0.0026	1/6	ND	0.017	1	2/5	ND	0.0013	0

[1]Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-500S, MW-506S, MW-507S, MW-508S, MW-3S.

[1]Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-500D, MW-506D, MW-507D, MW-508D, W-6, W-7, MW-3D.

[2] Results from monitoring wells MW-504S, MW-511S, MW-523S, MW-524S, MW-525S, MW-526S

[3] Results from monitoring wells MW-504D, MW-511D, MW-523D, MW-525D, MW-526D

[4]See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-8
September 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 2
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	0	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	2
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	0	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	0	0
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0	2
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	1	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	0	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	0	0
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**6**	**17**
			INTERPRETATION (6 to 14):	**LIMITED EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	
			INTERPRETATION (15 to 20):	**ADEQUATE EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 3-9

September 2007 - Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 4

OMC Plant 2

	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Non-Elevated VOC Area[1]			Highest VOC Area in Shallow[2]				Highest VOC Area in Deep[3]			
Analysis		Frequency of Detection	Range in Concentration (mg/L)		Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range	Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	13/13	-9.47	4.9	5/5	0.17	1.05	1	3/3	0.18	0.27	3
Nitrate (mg/L)	< 1 mg/L	5/13	ND	0.76	4/6	ND	13	4	2/6	ND	0.31	6
Iron II (mg/L)	> 1 mg/L	13/13	1.68	5.87	3/6	ND	1.35	1	6/6	4.47	13	6
Sulfate (mg/L)	< 20 mg/L	13/13	1.3	92	6/6	44	130	0	6/6	1.3	1200	2
Sulfide (mg/L)	> 1 mg/L	3/13	ND	1.8	0/6	ND	ND	0	1/6	ND	2.6	1
Methane (mg/L)	> 0.5 mg/L	13/13	0.0039	6.3	6/6	0.022	1.1	1	6/6	0.022	1.2	1
Oxidation Reduction Potential[4] (mV)	< -100 mV	13/13	-154.2	-15.1	6/6	-300	150.9	1	6/6	-308.0	-103.3	6
pH	5 < pH < 9	13/13	6.62	7.69	6/6	6.8	7.04	6	6/6	6.99	7.24	6
TOC (mg/L)	> 20 mg/L	10/13	ND	46	6/6	2.9	8.9	0	6/6	5.1	610	3
Temperature (degrees Celsius)	> 20C	13/13	13.94	23.11	6/6	17.02	26.24	3	6/6	14.7	17.96	0
Alkalinity (mg/L)	> 2x background	13/13	270	1400	6/6	300	430	0	6/6	370	1700	0
Chloride (mg/L)	> 2x background	13/13	1.2	2400	6/6	13	140	0	6/6	110	310	0
BTEX (mg/L)	> 0.1 mg/L	4/13	ND	467.9	0/6	ND	ND	0	1/6	ND	0.59	1
Tetrachloroethene (mg/L)	NA	0/13	ND	ND	0/6	ND	ND	NA	0/6	ND	ND	NA
Trichloroethene (mg/L)	NA	0/13	ND	ND	5/6	ND	0.89	NA	1/6	ND	0.15	NA
cis-1,2-dichloroethene (mg/L)	NA	5/13	ND	0.36	6/6	0.018	2.8	NA	6/6	0.12	120	NA
trans-1,2-dichloroethene (mg/L)	NA	1/13	ND	0.0007	4/6	ND	0.013	NA	2/6	ND	0.094	NA
Vinyl chloride (mg/L)	NA	7/15	ND	0.33	6/6	0.013	3.3	NA	6/6	0.38	13	NA
1,1,1-trichloroethane (mg/L)	NA	0/13	ND	ND	0/6	ND	ND	NA	0/6	ND	ND	NA
1,1-dichloroethane (mg/L)	NA	2/13	ND	0.00092	3/6	ND	0.011	NA	0/6	ND	ND	NA
Chloroethane (mg/L)	NA	0/13	ND	ND	0/6	ND	ND	NA	0/6	ND	ND	NA
Ethene (mg/L)	> 0.01 mg/L	9/13	ND	1.2	5/6	ND	0.013	1	5/6	ND	0.73	4
Ethane (mg/L)	> 0.01 mg/L	7/13	ND	1.0036	5/6	ND	0.049	4	5/6	ND	0.068	1

[1]Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-507S, MW-513S, MW-515S, MW-516S, MW-3S, MW-530S

[1]Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-507D, MW-513D, MW-515D, MW-516D, MW-3D, W-4, MW-530D

[2] Results from monitoring wells MW-11S, MW-512S, MW-514S, MW-527S, MW-528S, MW-529S

[3] Results from monitoring wells MW-11D, MW-512D, MW-514D, MW-527D, MW-528D, MW-529D

[4]See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-10
September 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 4
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	0	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	2
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	0	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	0	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	0	0
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	1	1
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	0	2
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	2
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	1	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	2	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	2	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	2	0
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	0	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	3
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**12**	**22**
			INTERPRETATION (6 to 14):	**LIMITED EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	
			INTERPRETATION (>20):	**STRONG EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED SOLVENTS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 3-11

Site Parameters to Screen for Anaerobic Biodegradation Processes in the Shallow and Deep Aquifer in Area 5

OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[4]	Non-Elevated VOC Area[1]			Highest VOC Area in Shallow[2]				Highest VOC Area in Deep[3]			
		Frequency of Detection	Range in Concentration (mg/L)		Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range	Frequency of Detection	Range in Concentration (mg/L)		Number of Samples in Preferred Range
Oxygen (mg/L)	< 0.5 mg/L	11/11	0.12	4.3	6/6	0.01	1.76	2	7/7	-0.28	1.55	6
Nitrate (mg/L)	< 1 mg/L	9/12	ND	0.32	2/6	ND	0.4	6	4/7	ND	1.7	6
Iron II (mg/L)	> 1 mg/L	12/12	ND	15.8	6/6	2.4	23	6	7/7	6.06	52	7
Sulfate (mg/L)	< 20 mg/L	12/12	1.7	430	6/6	4.6	710	4	7/7	20	1100	0
Sulfide (mg/L)	> 1 mg/L	0/12	ND	ND	2/6	ND	1.2	2	1/7	ND	1.2	1
Methane (mg/L)	> 0.5 mg/L	12/12	0.009	3.1	6/6	0.13	2.2	5	7/7	.14	1.2	4
Oxidation Reduction Potential[4] (mV)	< -100 mV	12/12	-84.9	-160	6/6	-80	-229.3	4	7/7	-86.3	-173.0	5
pH	5 < pH < 9	12/12	6.57	7.51	6/6	6.8	7.18	6	7/7	6.57	7.14	7
TOC (mg/L)	> 20 mg/L	11/12	ND	11	6/6	3.7	29	1	7/7	2.9	7.8	0
Temperature (degrees Celsius)	> 20C	12/12	8.89	13.2	6/6	15.57	20.13	1	7/7	13.83	15.26	0
Alkalinity (mg/L)	> 2x background	12/12	270	470	6/6	410	510	0	7/7	360	470	0
Chloride (mg/L)	> 2x background	12/12	28	370	6/6	88	370	0	7/7	140	450	1
BTEX (mg/L)	> 0.1 mg/L	1/12	ND	0.00026	0/6	ND	ND	0	0/7	ND	ND	0
Tetrachloroethene (mg/L)	NA	0/12	ND	ND	0/6	ND	ND	NA[7]	0/7	ND	ND	NA[7]
Trichloroethene (mg/L)	NA	0/12	ND	ND	2/6	ND	0.0042	NA[7]	4/7	ND	100	NA[7]
cis-1,2-dichloroethene (mg/L)	NA	7/12	ND	1.4	1/6	ND	0.3	NA[7]	7/7	6.3	120	NA[7]
trans-1,2-dichloroethene (mg/L)	NA	2/12	ND[5]	0.0029	0/6	ND	ND	NA[7]	4/7	ND	0.54	NA[7]
Vinyl chloride (mg/L)	NA	8/12	ND	0.89	5/6	ND	1.5	NA[7]	7/7	0.96	21	NA[7]
1,1,1-trichloroethane (mg/L)	NA	1/12	ND	0.0006	1/6	ND	0.0004	NA[7]	0/7	ND	ND	NA[7]
1,1-dichloroethane (mg/L)	NA	8/12	ND[5]	0.023	3/6	ND	0.0021	NA[7]	0/7	ND	ND	NA[7]
Chloroethane (mg/L)	NA	2/12	ND	0.61	1/6	ND	0.005	NA[7]	0/7	ND	ND	NA[7]
Ethene (mg/L)	> 0.01 mg/L	6/12	ND	1.2	6/6	0.0018	0.18	4	7/7	0.0072	0.34	6
Ethane (mg/L)	> 0.01 mg/L	7/12	ND	0.05	5/6	ND	0.16	4	4/7	ND	0.029	1

[1]Results from shallow monitoring wells where TCE was not detected. Monitoring wells MW-502S, MW-513S, MW-519S

[1]Results from deep monitoring wells where TCE was not detected. Monitoring wells MW-502D, MW-513D, MW-519D, W-9, W-10, W-11, W-12

[2] Results from monitoring wells MW-505S, MW-506S, MW-518S, MW-520S, MW-521S, MW-522S

[3] Results from monitoring wells MW-503D, MW-505D, MW-506D, MW-518D, MW-520D, MW-521D, MW-522D

[4]See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128.

ND = Not Detected

NA = Not Applicable

BTEX concentration is the sum of the detected concentrations only.

TABLE 3-12
September 2007 - Screening for Anaerobic Biodegradation Processes and Interpretation of Screening Results in Area 5
OMC Plant 2

Analysis	Preferred Concentration Indicating Anaerobic Biodegradation[1]	Interpretation[1]	Value[1]	Points Awarded for Shallow Aquifer[1,2]	Points Awarded for Deep Aquifer[1,2]
Oxygen (mg/L)	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations.	3	0	3
Oxygen (mg/L)	> 5 mg/L	Not tolerated, however, VC may be oxidized aerobically.	-3	0	0
Nitrate (mg/L)	< 1 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	2
Iron II	> 1 mg/L	Reductive pathway possible; VC may be oxidized under Fe (III)-reducing conditions.	3	3	3
Sulfate (mg/L)	< 20 mg/L	At higher concentrations, may compete with reductive pathway.	2	2	0
Sulfide (mg/L)	> 1 mg/L	Reductive pathway possible.	3	0	0
Methane (mg/L)	< 0.5 mg/L	VC oxidizes.	0	0	0
Methane (mg/L)	> 0.5 mg/L	Ultimate reductive daughter product, VC accumulates.	3	3	3
Oxidation Reduction Potential (mV)	< 50 mV	Reductive pathway possible.	1	0	0
Oxidation Reduction Potential (mV)	< -100 mV	Reductive pathway likely.	2	2	2
pH	5 < pH < 9	Optimal range for reductive pathway.	0	0	0
pH	5 > pH > 9	Outside optimal range for reductive pathway.	-2	0	0
TOC (mg/L)	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic.	2	0	0
Temperature (degrees Celsius)	> 20C	At T .20C, biochemical process is accelerated.	1	0	0
Alkalinity (mg/L)	> 2x background	Results from interaction between CO_2 and aquifer materials.	1	0	0
Chloride (mg/L)	> 2x background	Daughter product of organic chlorine.	2	0	0
BTEX (mg/L)	> 0.1 mg/L	Carbon and energy source; drives dechlorination.	2	0	0
Tetrachloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Material released.	0	0	0
Trichloroethene (mg/L)	NA	Daughter product of PCE.	2	0	0
Dichloroethene (mg/L)	NA	Daughter product of TCE; If cis is > 80% of total DCE it is likely a daughter product, 1,1DCE can be chemical reaction product of TCA.	2	0	2
Vinyl chloride (mg/L)	NA	Daughter product of DCE.	2	2	2
1,1,1-trichloroethane (mg/L)	NA	Material released.	0	0	0
1,1-dichloroethane (mg/L)	NA	Daughter product of TCA under reducing conditions.	2	0	0
Chloroethane (mg/L)	NA	Daughter product of DCA or VC under reducing conditions.	2	0	0
Ethene (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2	2
Ethane (mg/L)	> 0.01 mg/L	Daughter product of VC/ethene.	2	2	0
Ethene (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
Ethane (mg/L)	> 0.1 mg/L	Daughter product of VC/ethene.	3	0	0
			SCORE:	**18**	**19**
			INTERPRETATION (6 to 14):	**LIMITED EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	
			INTERPRETATION (15 to 20):	**ADEQUATE EVIDENCE FOR ANAEROBIC BIODEGRADATION OF CHLORINATED ORGANICS**	

[1] See Table 2.3 in *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* , EPA/600/R-98/128.
[2] Points awarded only when 50 percent or more of results for a particular parameter for the wells indicated were at the preferred concentration.
NA = Not applicable.

TABLE 4-1
Source and Plume Data Used in BICHLOR Modeling
OMC Plant 2

Area	Source Width (ft)	Source Thickness in Saturated Zone (ft)	Concentration Data: Distance from Source (ft)	Location	TCE (mg/L)	cis-1,2-DCE (mg/L)	VC (mg/L)	Notes[a]
2	100	15	0	MW-523D	210	70	0.57	Concentrations of cis-1,2-DCE and VC included in the source because of the DNAPL in the area
			100	MW-525D	78	5	0.790	Location may be near DNAPL so TCE concentration may be biased high.
			300	MW-511D	0.034	0.0089	0.051	
4	10	15	0	MW-529S	0.830	2.0	0.850	
			150	MW-527S	0.73	0.54	0.49	
			450	MW-516S	<0.0005	<0.0005	<0.0005	
5	300	15	0		44			Based on maximum TCE concentration observed in MW-520D of 44 mg/L
			100	MW-522D	23	9.3	0.2	
			200	MW-521D	1.1	8.5	3.1	
			400	MW-510D	0.00012	0.00072	0.00031	
			600	MW-513D	0.0011	0.0007	0.00045	

[a]Concentrations based on analytical results from February 2007 baseline sampling unless otherwise noted
ft – feet
mg/L – milligrams per liter
VC – vinyl chloride

TABLE 4-2
BIOCHLOR Input Parameters
OMC Plant 2

Input	Value	Source
1. Advection Data		
Hydraulic Conductivity (K)		
Area 2	0.0043 cm/sec	Based on the geometric mean of hydraulic conductivities estimated from in situ hydraulic testing during RI for monitoring wells in each area.
Area 4	0.031 cm/sec	
Area 5	0.0054 cm/sec	
Hydraulic Gradient (i)		
Area 2	0.0011 ft/ft	Based on the calculated hydraulic gradients for each area from water levels collected in February 2007.
Area 4	0.0038 ft/ft	
Area 5	0.0013 ft/ft	
Effective Porosity (n)	0.3	Effective porosity assumed to be average saturated total porosity of the aquifer materials measured during the RI
2. Dispersion Data		
Alpha (x)		
Area 2 (length = 600 ft)	19.8 ft	Calculated using BIOCHLOR Option 3 (modified Xu & Eckstein) for an estimated plume length in feet[a]
Area 4 (length = 400 ft)	16.2 ft	
Area 5 (length = 1000 ft)	24.9 ft	
Alpha y/alpha x	0.10	BIOCHLOR default[a]
Alpha z/alpha x	1.E-99	BIOCHLOR default[a]
3. Adsorption Data		
Soil Bulk Density (rho)	1.45 kg/L	Based on an average density measured for site soil during RI.
Fraction Organic Carbon (f_{oc})		Average total organic carbon (TOC) measured for the aquifer materials during the RI
Shallow Zone	0.00115	
Deep Zone	0.00097	
Partition Coefficient (K_{oc})		
TCE	166 L/Kg	Literature values used in the evaluation of fate and transport of CVOCs in the RI[b]
cis-1,2-DCE	35.5 L/kg	
VC	18.6 L/kg	
4. Biotransformation Data		
Zone 1 half-life (yrs)		
TCE	See Table 3	Determined based on an iterative process that resulted in the best match between observed concentrations of TCE, cis-1,2-DCE and VC data to model results along centerline flowpath.
cis-1,2-DCE		
VC		
5. General Data		
Simulation Time	30 yr	Time from potential release start date (1977) to current 2007 field data used for calibration.

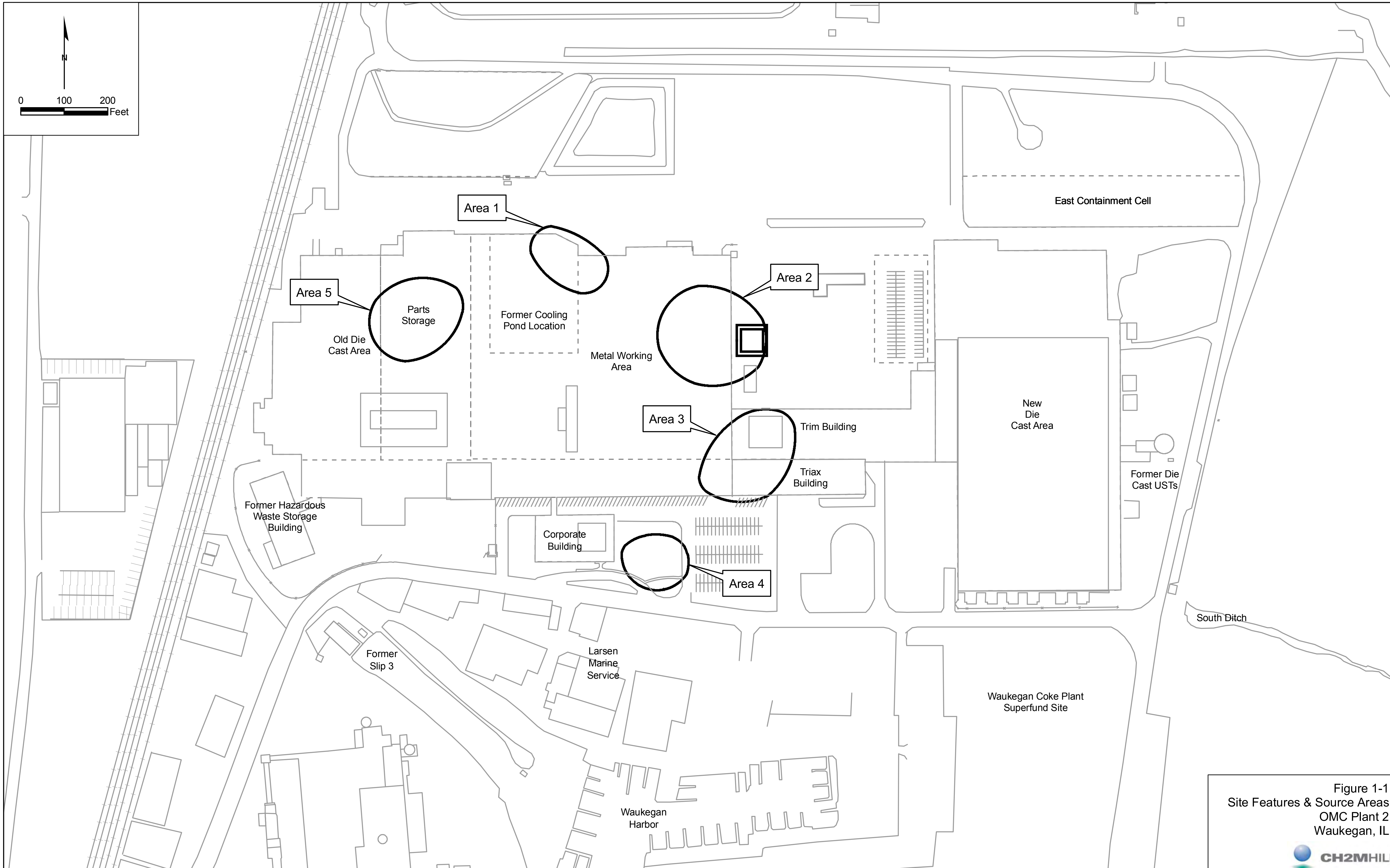
[a]BIOCHLOR Natural Attenuation Decision Support System User's Manual (Aziz et al., 1998)
[b]Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002)

TABLE 4-3
Resulting Half-Lives
OMC Plant 2

	Modeled Half Lives (yr)			Typical Half Lives (yr)		
Compound	**Area 2**	**Area 4**	**Area 5**	**Aziz**[a]	**USEPA**[b]	**Howard**[c]
TCE	1.0	0.15	0.7	0.77 to 13.9	0.047 to 2.3	0.27 to 4.5
cis-1,2-DCE	0.3	0.08	1.0	0.21 to 3.9	NA	0.27 to 4.5
VC	0.6	0.06	0.6	0.27 to 5.8	0.033 to no degradation	0.31 to 2.0

NA – Not available
[a]Aziz et al. 2000
[b]USEPA 1999
[c]Howard et al. 1991

Figures



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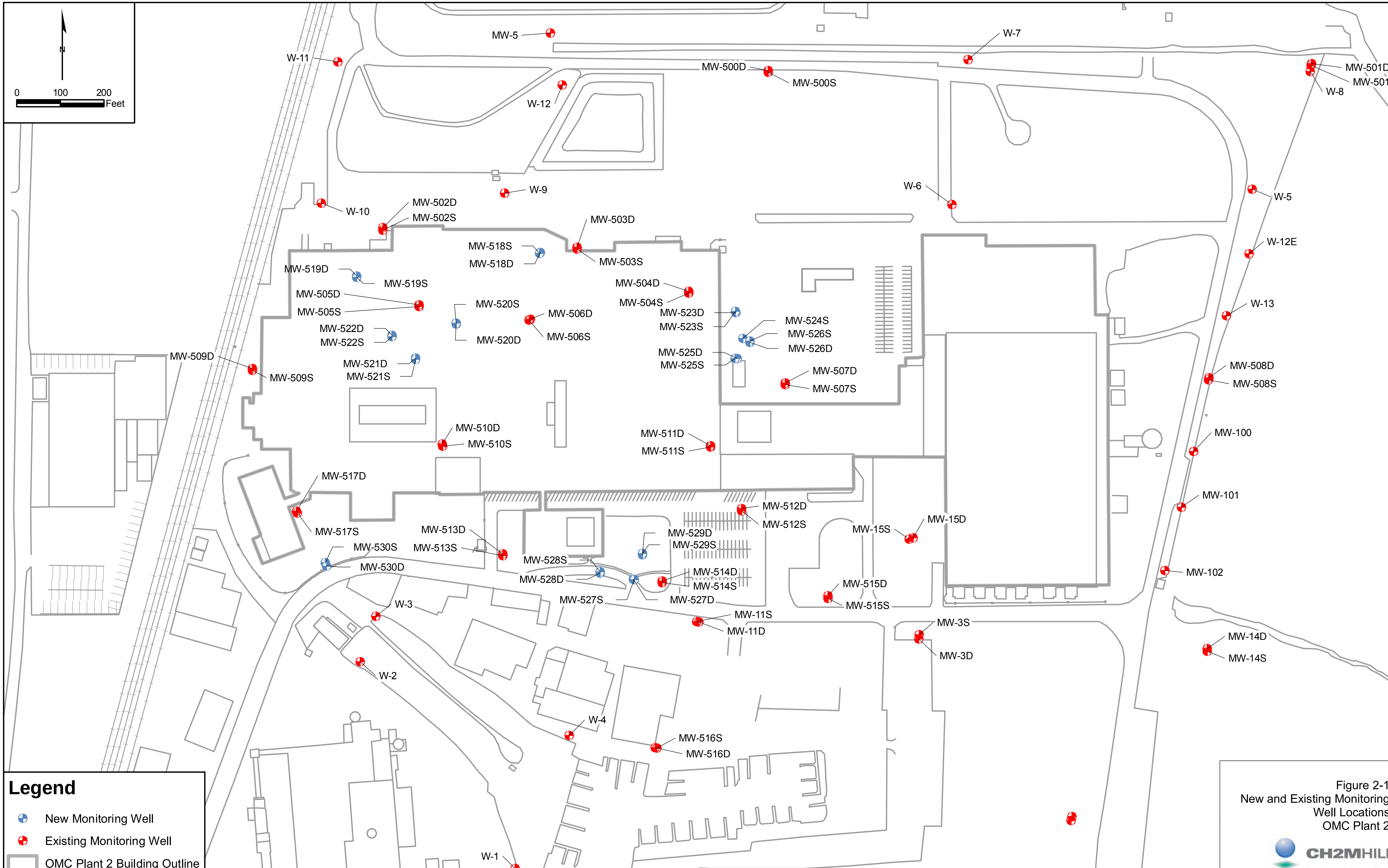

N
0 100 200 Feet
MW-5
W-11
W-7
MW-500D
MW-500S
MW-501D
MW-501S
W-8
W-12
W-9
W-10
W-6
W-5
MW-502D
MW-502S
MW-503D
MW-503S
MW-518S
MW-518D
W-12E
MW-519D
MW-519S
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MW-508S
MW-510D
MW-510S
MW-511D
MW-511S
MW-100
MW-517D
MW-517S
MW-101
MW-512D
MW-512S
MW-15D
MW-15S
MW-513D
MW-513S
MW-530S
MW-530D
MW-529D
MW-529S
MW-528S
MW-528D
MW-514D
MW-514S
MW-102
MW-515D
MW-515S
MW-527S
MW-527D
W-3
MW-11S
MW-11D
MW-3S
MW-3D
MW-14D
MW-14S
W-2
W-4
MW-516S
MW-516D
W-1
Legend
New Monitoring Well
Existing Monitoring Well
OMC Plant 2 Building Outline
Figure 2-1
New and Existing Monitoring
Well Locations
OMC Plant 2
CH2MHILL
MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\041107\FIGURE1-2_NEW_EXISTING_MW_PZ.MXD 8/30/2007 16:42:21

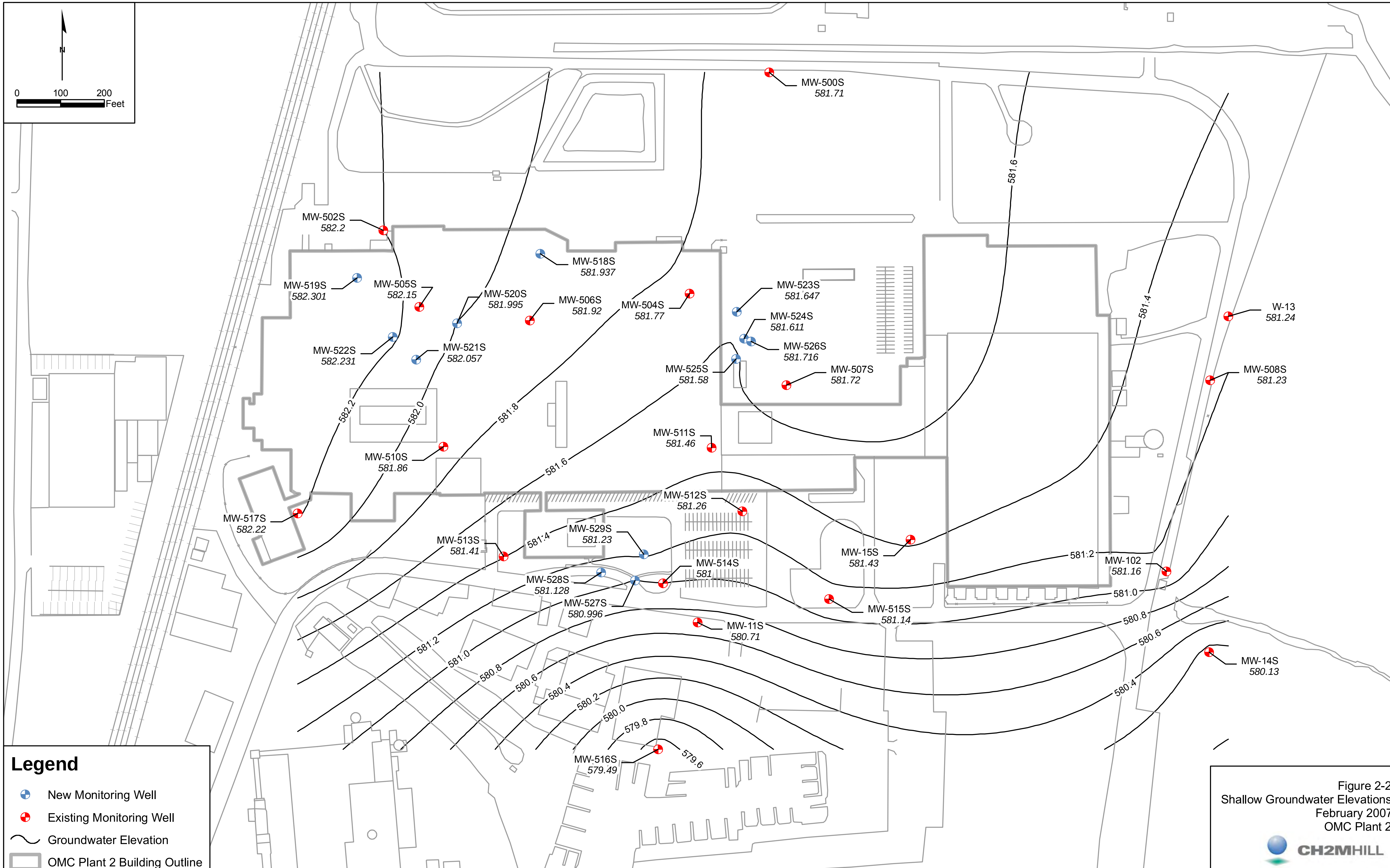


Figure 2-2
Shallow Groundwater Elevations
February 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-02_SHALLOWGWELEV.MXD FIGURE02-02_SHALLOWGWELEV.MXD 8/10/2007 12:40:30

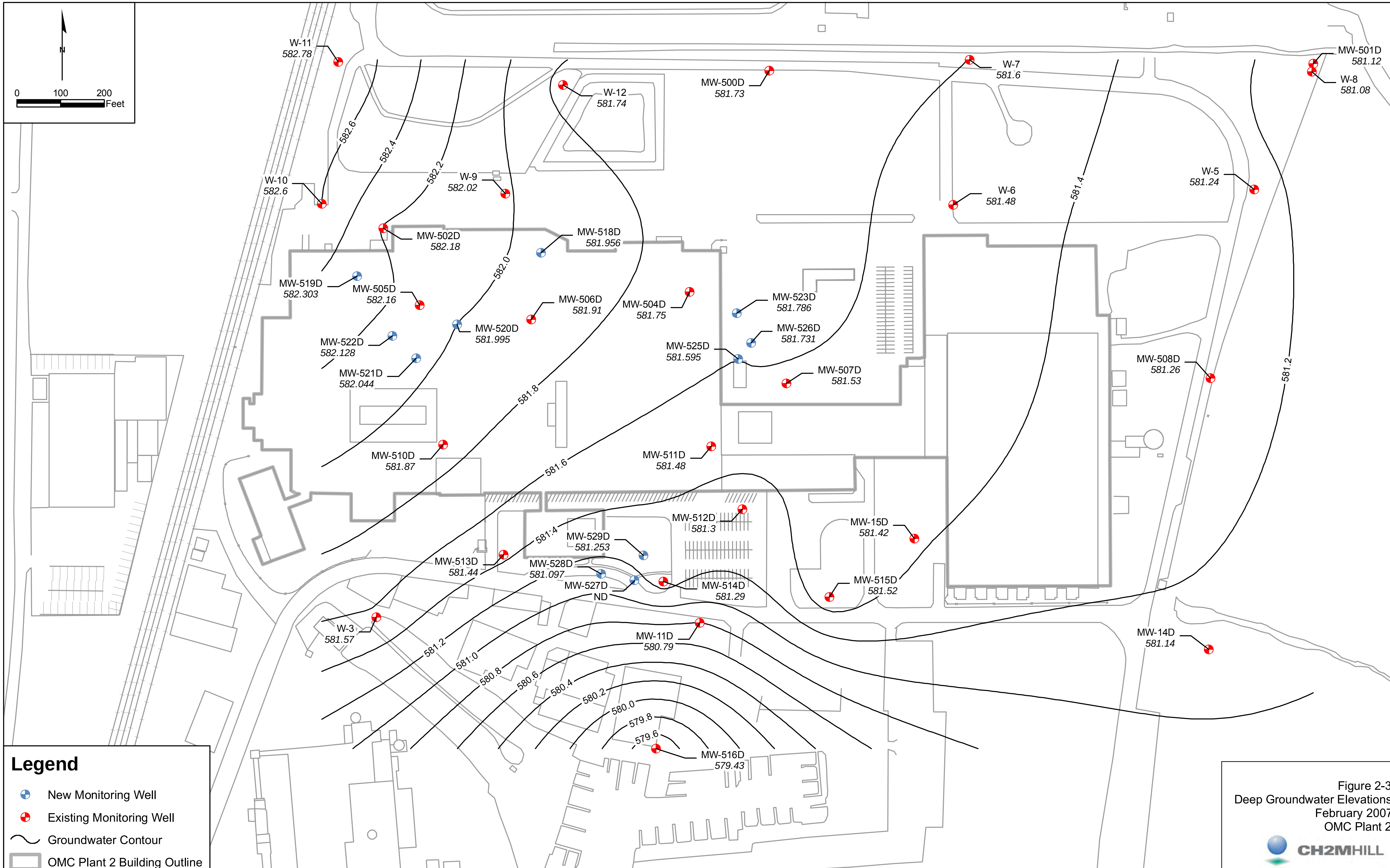


Figure 2-3
Deep Groundwater Elevations
February 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-03_DEEPGWELEV.MXD FIGURE02-03_DEEPGWELEV.MXD 8/10/2007 12:51:37

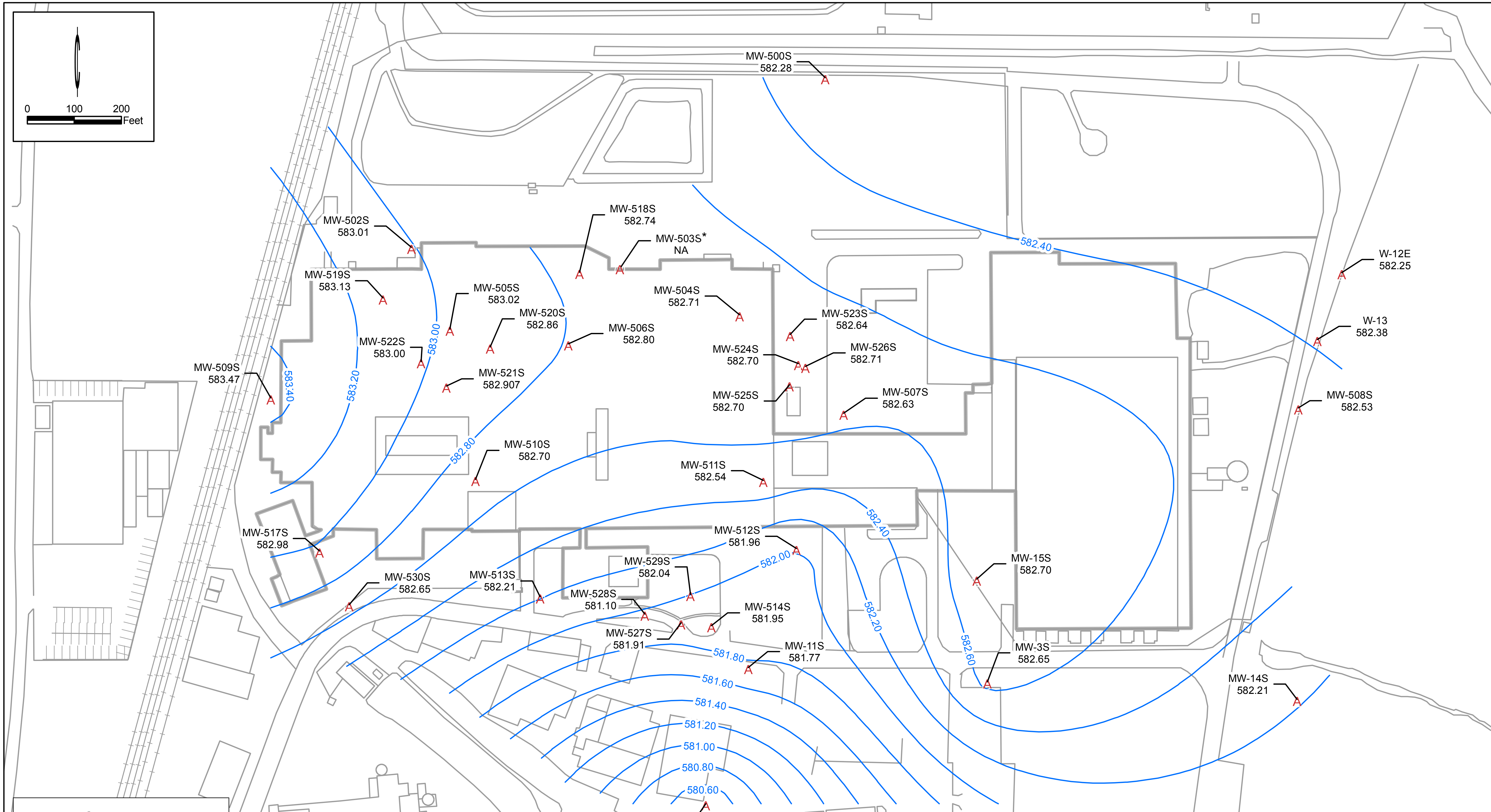
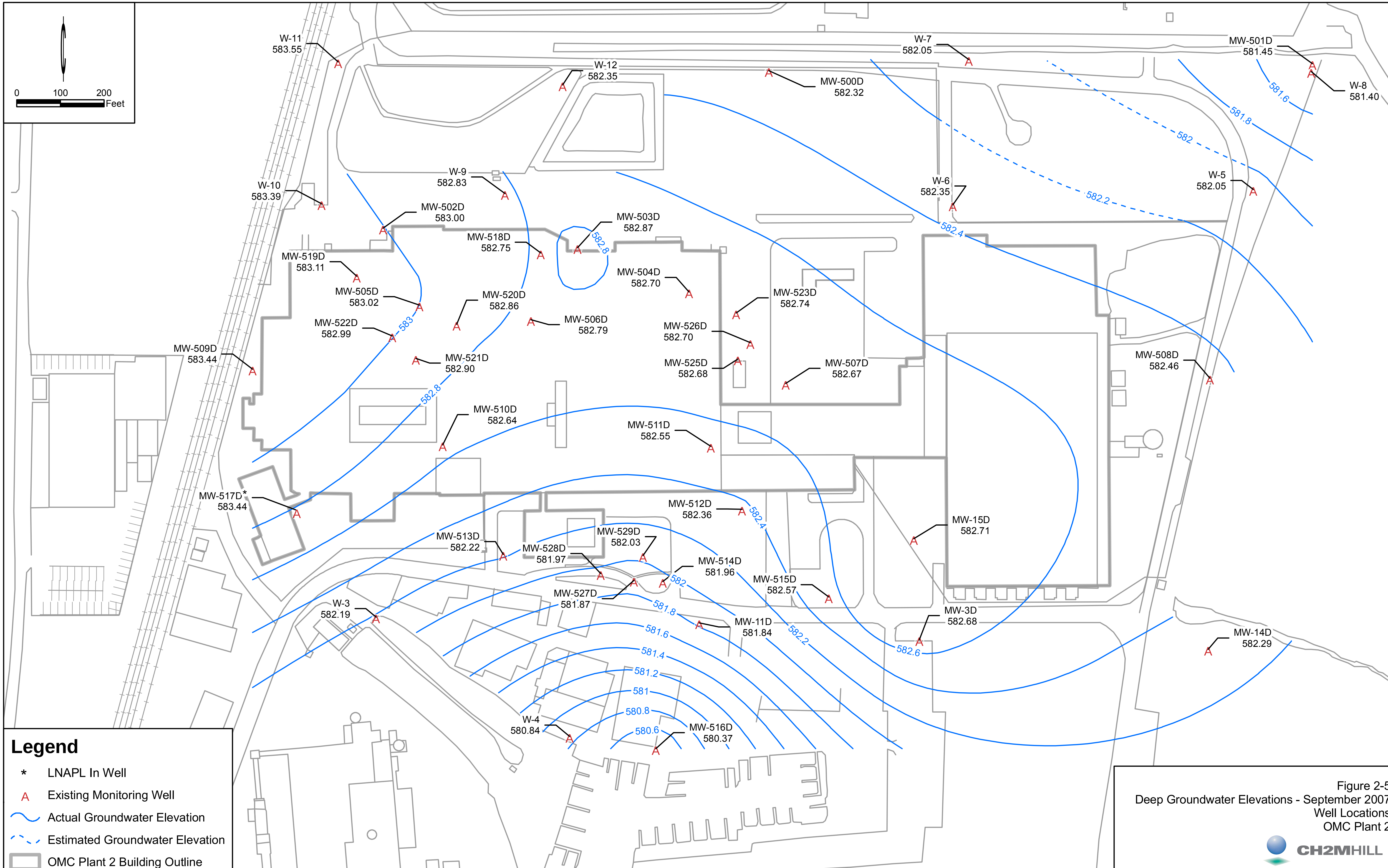


Figure 2-4
Shallow Groundwater Elevations - September 2007
Well Locations
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-02 - SHALLOWAQUIFERSEPT07.MXD 1/11/2008 16:12:55



Legend

- * LNAPL In Well
- Existing Monitoring Well
- Actual Groundwater Elevation
- Estimated Groundwater Elevation
- OMC Plant 2 Building Outline

Figure 2-5
Deep Groundwater Elevations - September 2007
Well Locations
OMC Plant 2

CH2MHILL

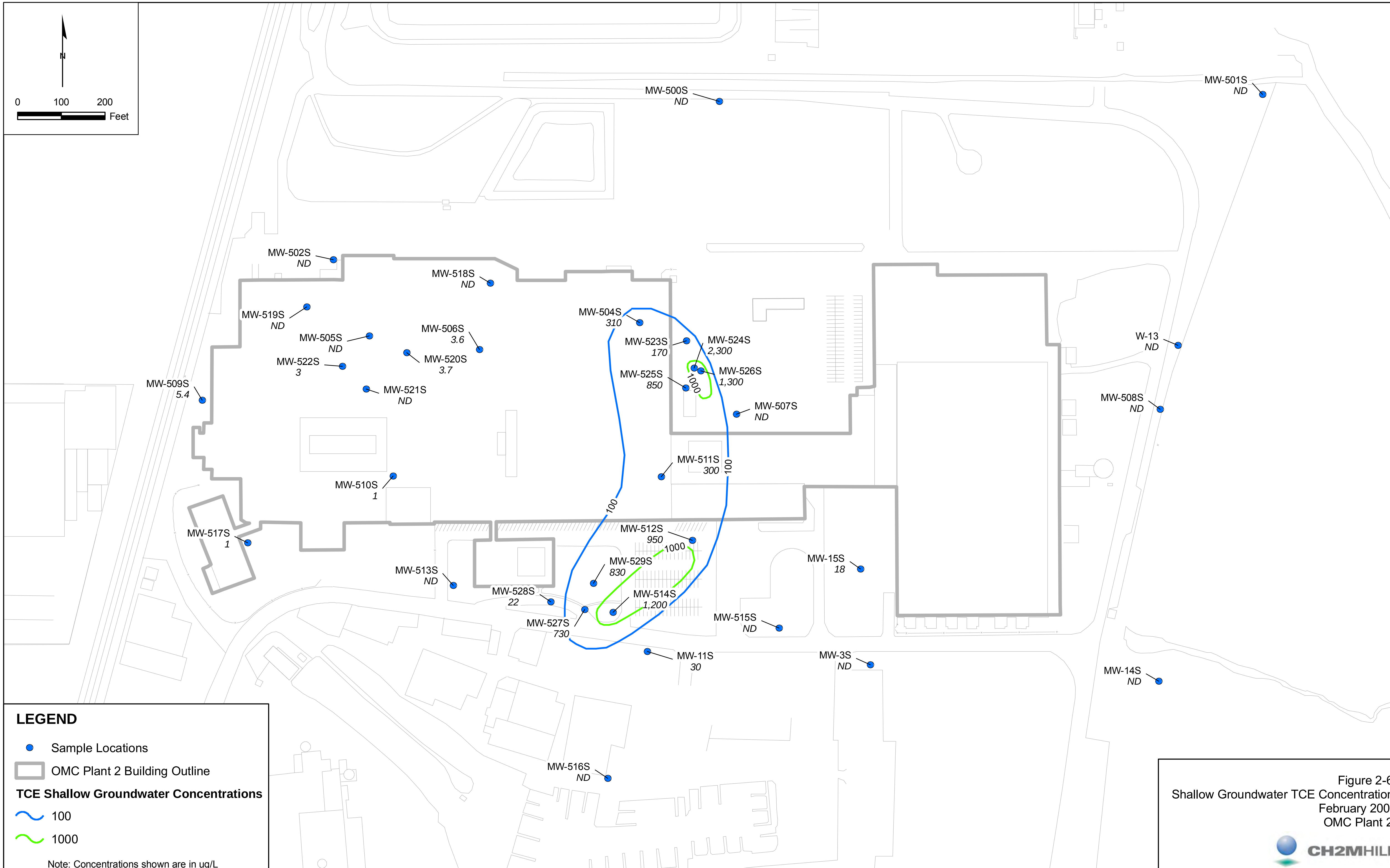
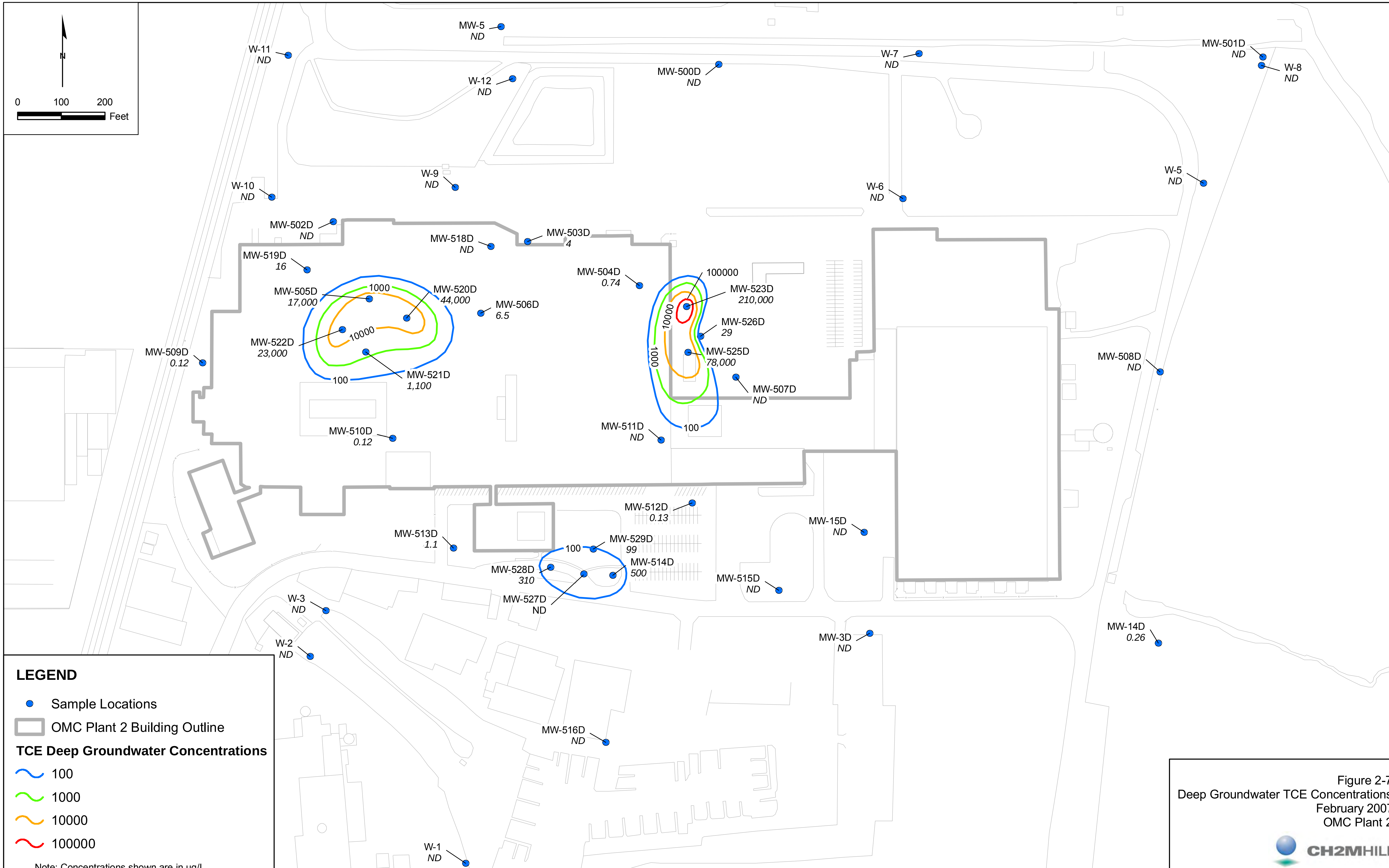


Figure 2-6
Shallow Groundwater TCE Concentration
February 2007
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-05_TCESHALLOW.MXD FIGURE02-05_TCESHALLOW.MXD 8/10/2007 12:54:11



LEGEND

- Sample Locations
- OMC Plant 2 Building Outline

TCE Deep Groundwater Concentrations

- 100
- 1000
- 10000
- 100000

Note: Concentrations shown are in ug/L

Figure 2-7
Deep Groundwater TCE Concentrations
February 2007
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-06_TCEDEEP.MXD FIGURE02-06_TCEDEEP.MXD 8/10/2007 13:25:04

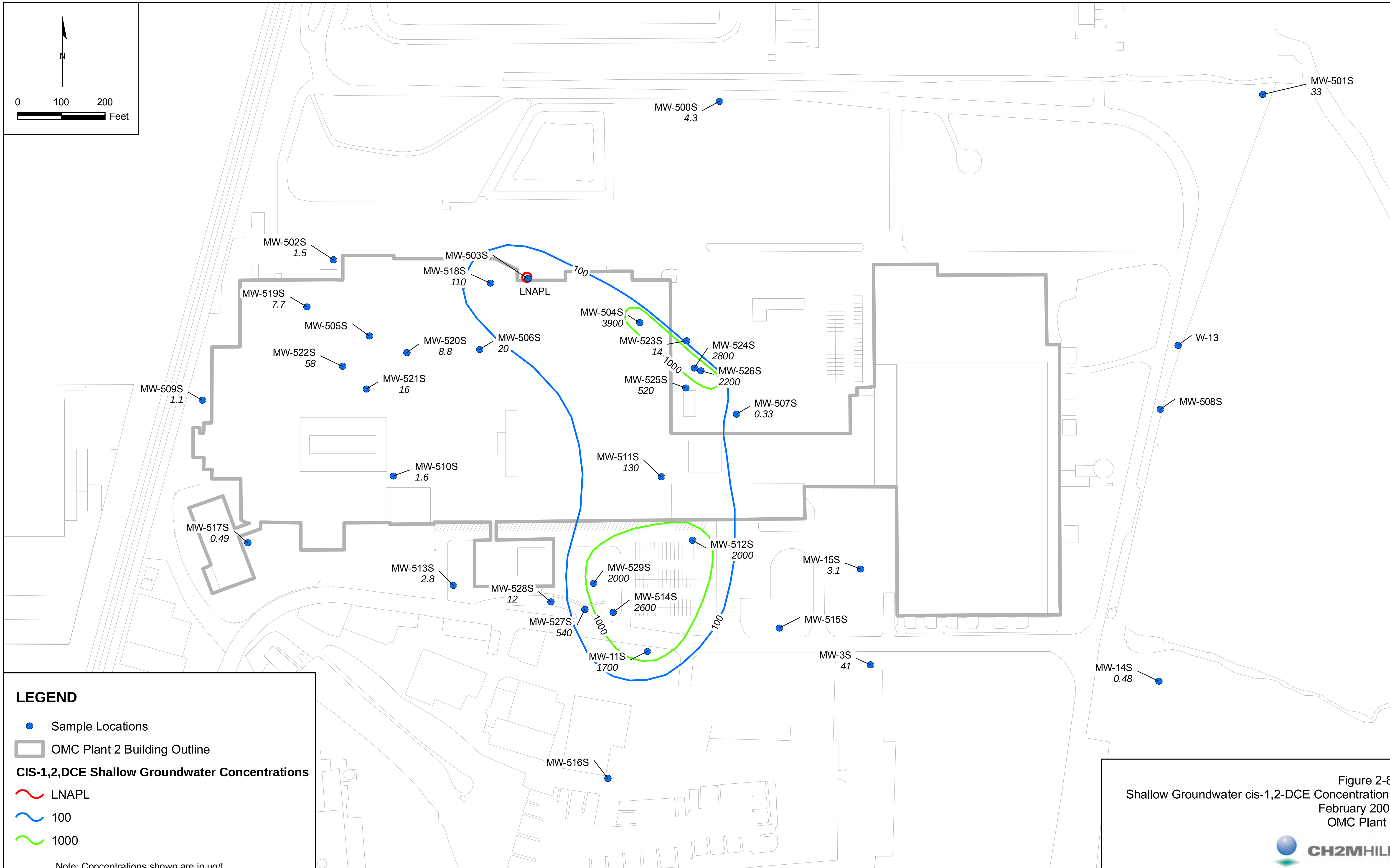
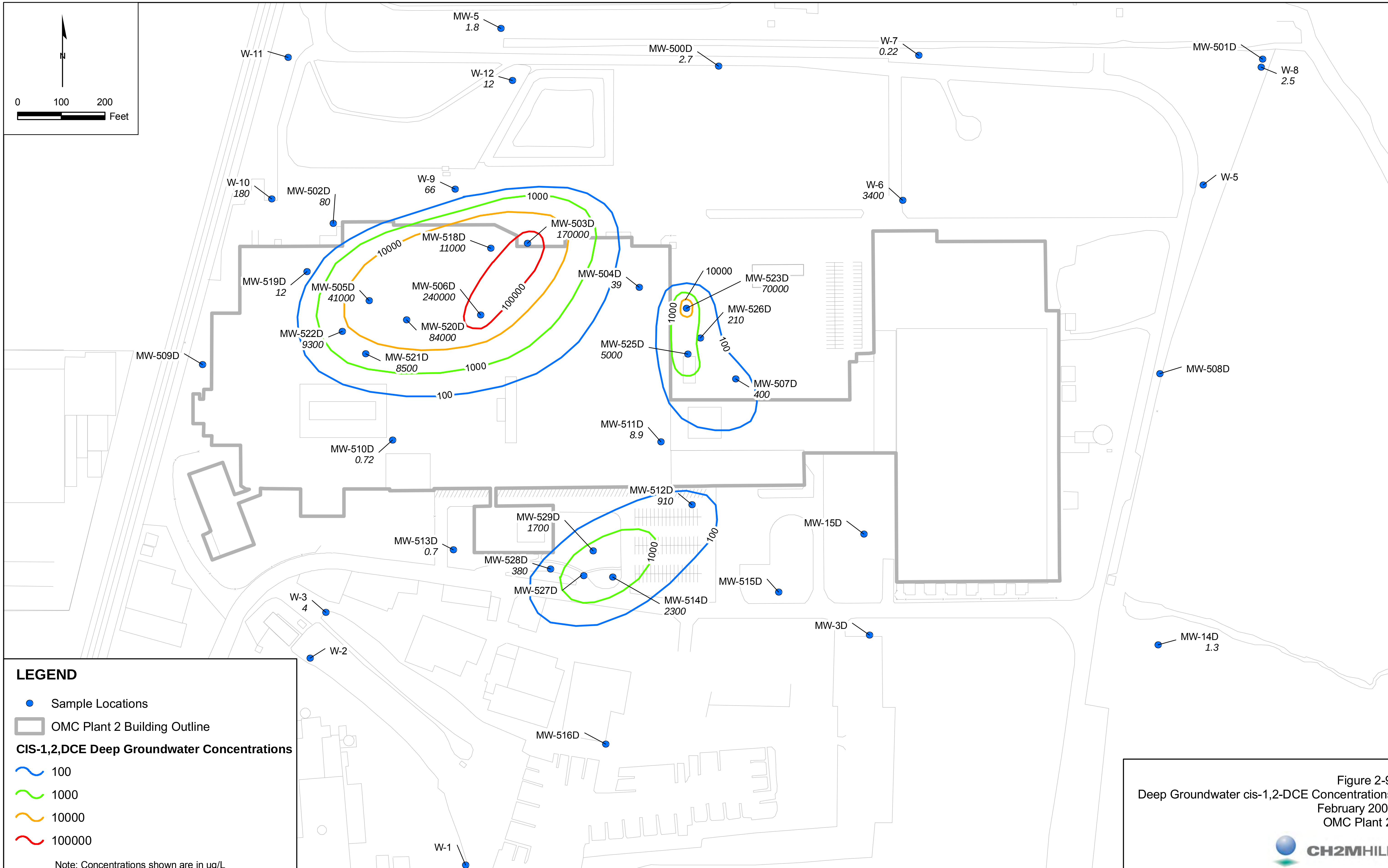


Figure 2-8
Shallow Groundwater cis-1,2-DCE Concentrations
February 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-07_CIS12DCESHALLOW.MXD FIGURE02-07_CIS12SHALLOW.MXD 8/10/2007 13:29:47



LEGEND

Sample Locations

OMC Plant 2 Building Outline

CIS-1,2,DCE Deep Groundwater Concentrations

100

1000

10000

100000

Note: Concentrations shown are in ug/L

Figure 2-9
Deep Groundwater cis-1,2-DCE Concentrations
February 2007
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-08_CIS12DCEDEEP.MXD FIGURE02-08_CIS12DCEDEEP.MXD 8/10/2007 13:37:49

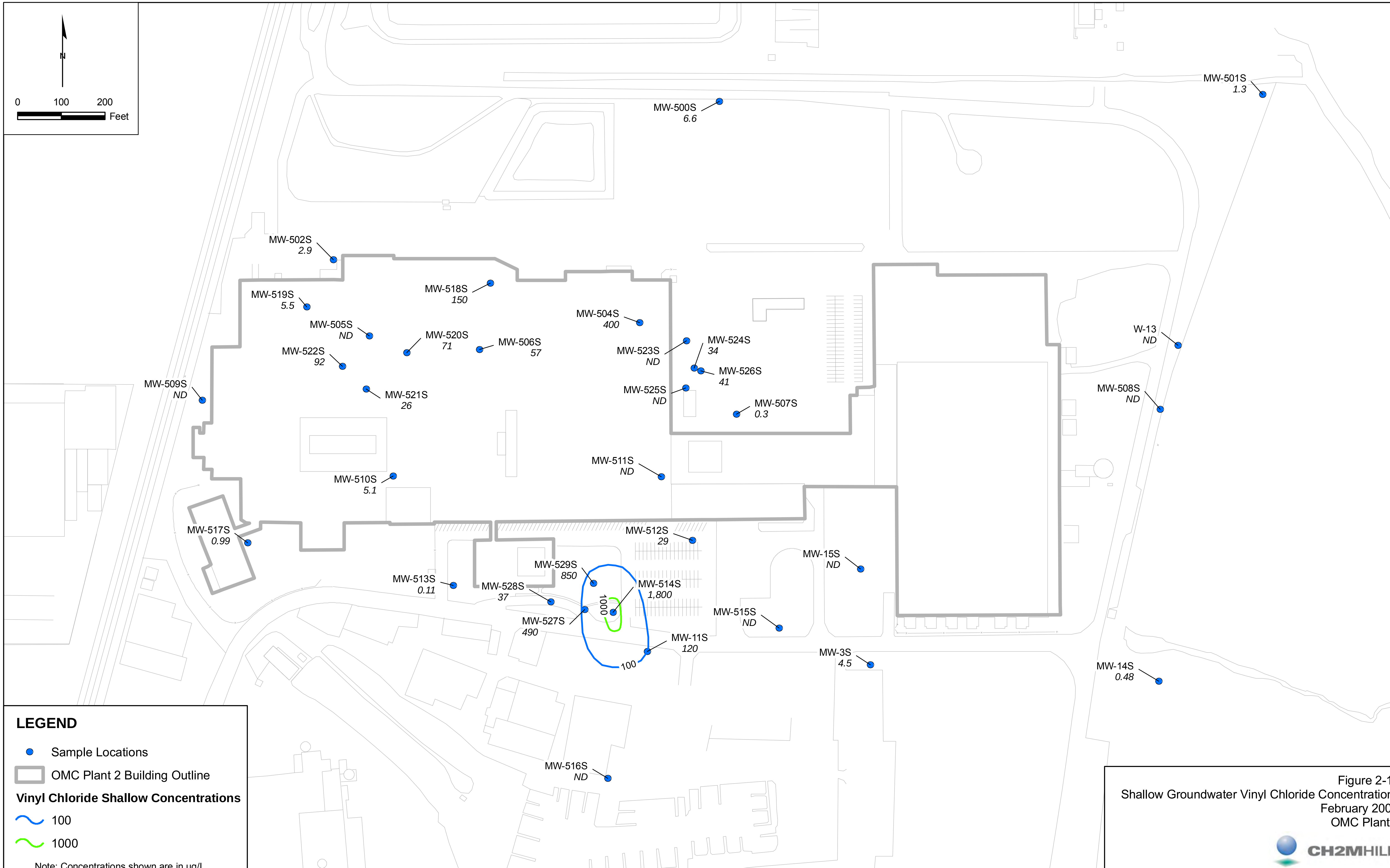


Figure 2-10
Shallow Groundwater Vinyl Chloride Concentrations
February 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-09_VINYLCHLORIDESHALLOW.MXD FIGURE02-09_VINYLCHLORIDESHALLOW.MXD 8/10/2007 13:42:11

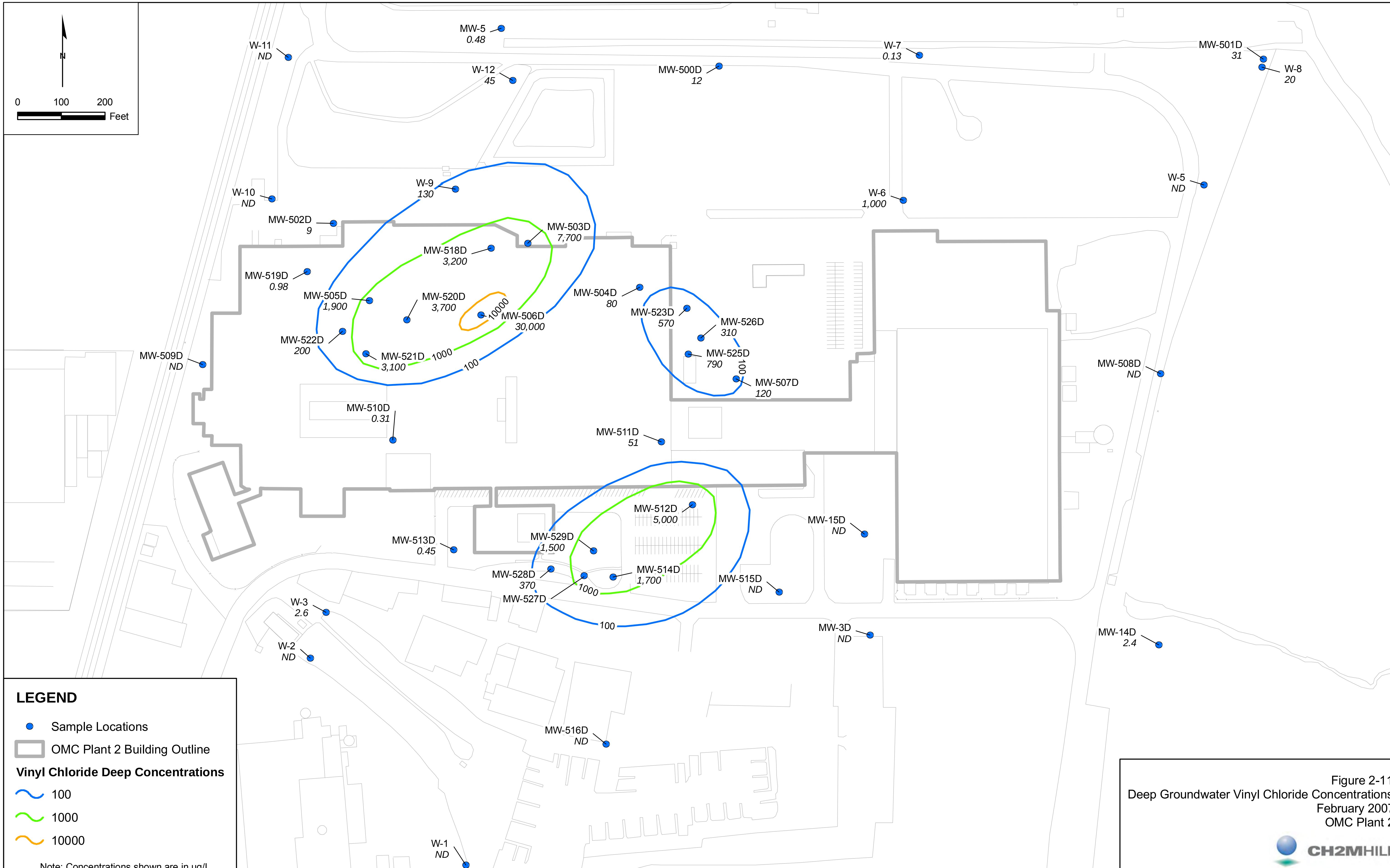
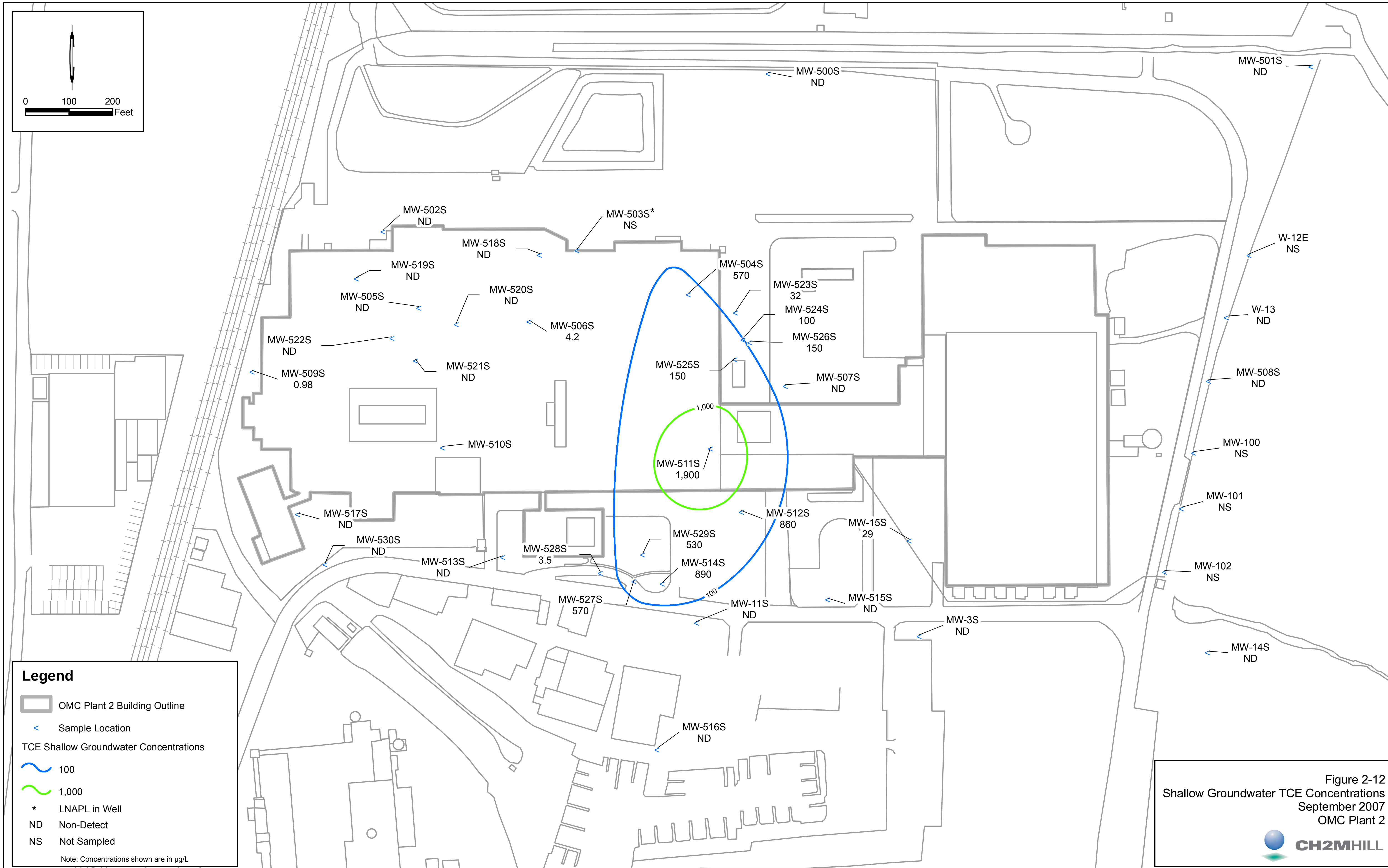
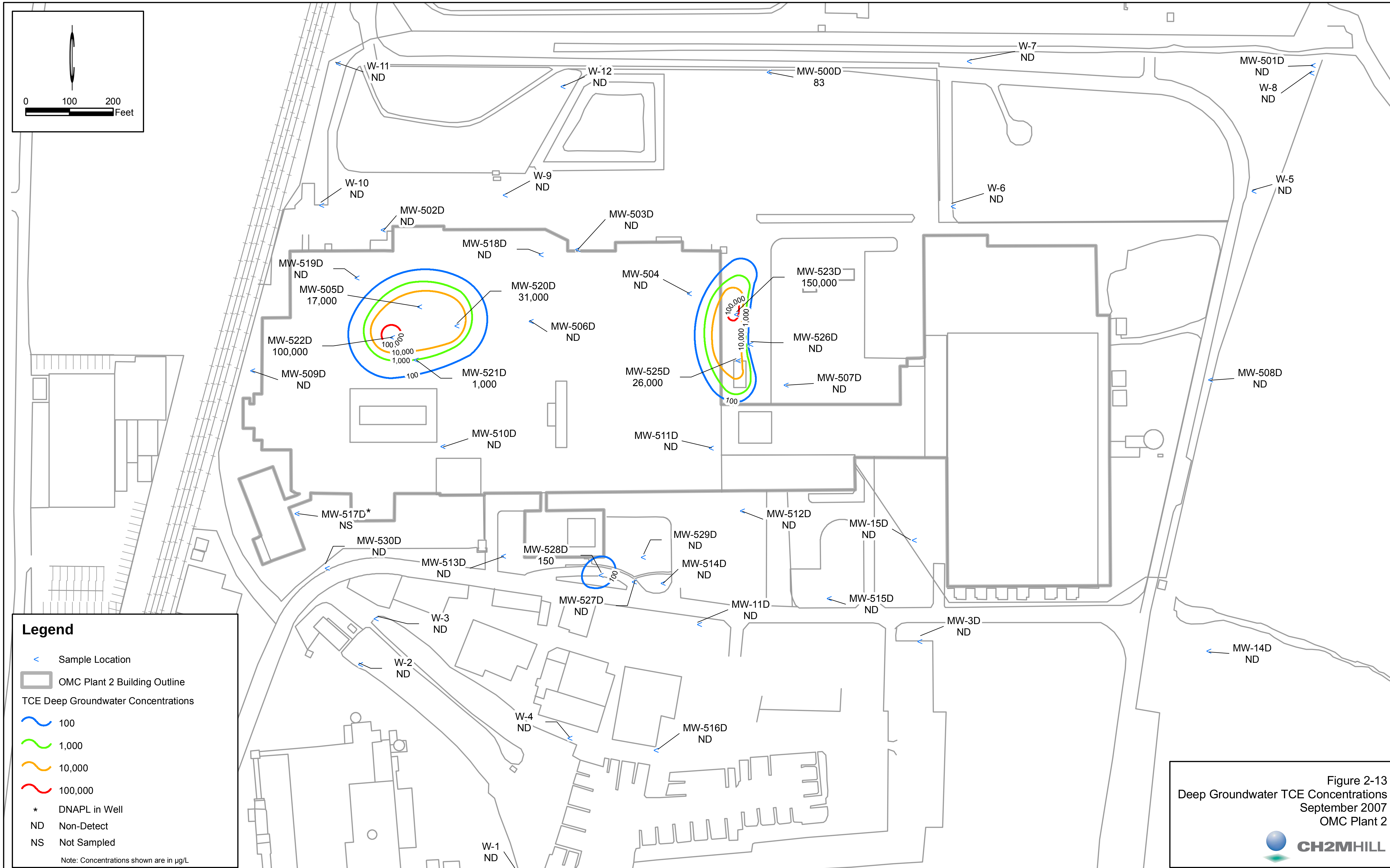


Figure 2-11
Deep Groundwater Vinyl Chloride Concentrations
February 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE02-10_VINYLCHLORIDEDEEP.MXD FIGURE02-10_VINYLCHLORIDEDEEP.MXD 8/10/2007 13:44:53



MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-05 - TCE SHALLOW SEPT 2007.MXD 1/17/2008 09:50:19



Legend

<	Sample Location
	OMC Plant 2 Building Outline

TCE Deep Groundwater Concentrations

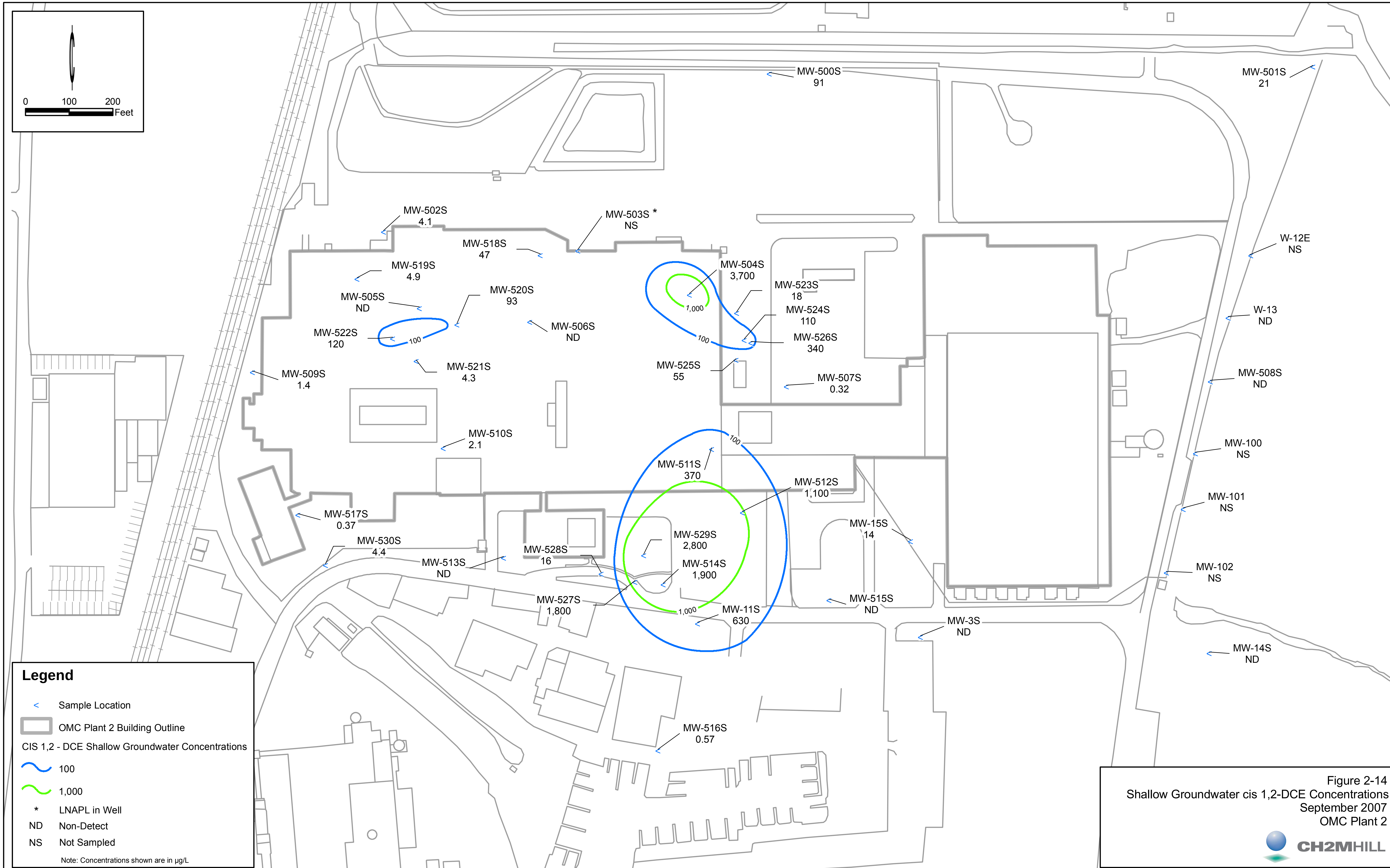
	100
	1,000
	10,000
	100,000
*	DNAPL in Well
ND	Non-Detect
NS	Not Sampled

Note: Concentrations shown are in µg/L

Figure 2-13
Deep Groundwater TCE Concentrations
September 2007
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-14 - TCE DEEP SEPT 2007.MXD 1/22/2008 13:03:45



MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-15 - CIS12DCE SHALLOW SEPT 2007.MXD 1/22/2008 13:25:53

0 100 200
Feet
W-11
ND
W-12
12
MW-500D
1,700
W-7
ND
MW-501D
0.30
W-8
0.83
W-10
20
W-9
1,400
MW-503D
110,000
W-6
3,200
W-5
ND
MW-502D
110
MW-518D
9,000
MW-519D
ND
MW-505D
30,000
MW-520D
60,000
MW-504
21
MW-523D
73,800
MW-522D
25,000
MW-506D
120,000
MW-526D
83
MW-509D
ND
MW-525D
5,900
MW-507D
360
MW-508D
ND
MW-521D
2,600
MW-510D
0.70
MW-511D
ND
MW-512D
120,000
MW-517D
NS
MW-529D
480
MW-15D
ND
MW-530D
ND
MW-528D
220
MW-513D
0.73
MW-514D
7,300
MW-527D
720
MW-515D
ND
W-3
5.5
MW-3D
ND
MW-11D
530
MW-14D
ND
W-2
ND
W-4
ND
MW-516D
ND
W-1
ND
100
1,000
10,000
100,000
Legend
Sample Location
OMC Plant 2 Building Outline
CIS 1,2 - DCE Deep Groundwater Concentrations
100
1,000
10,000
100,000
Dashed where Inferred
* DNAPL in Well
ND Non-Detect
NS Not Sampled
Note: Concentrations shown are in µg/L
Figure 2-15
Deep Groundwater CIS 1,2 - DCE Concentrations
September 2007
OMC Plant 2
CH2MHILL

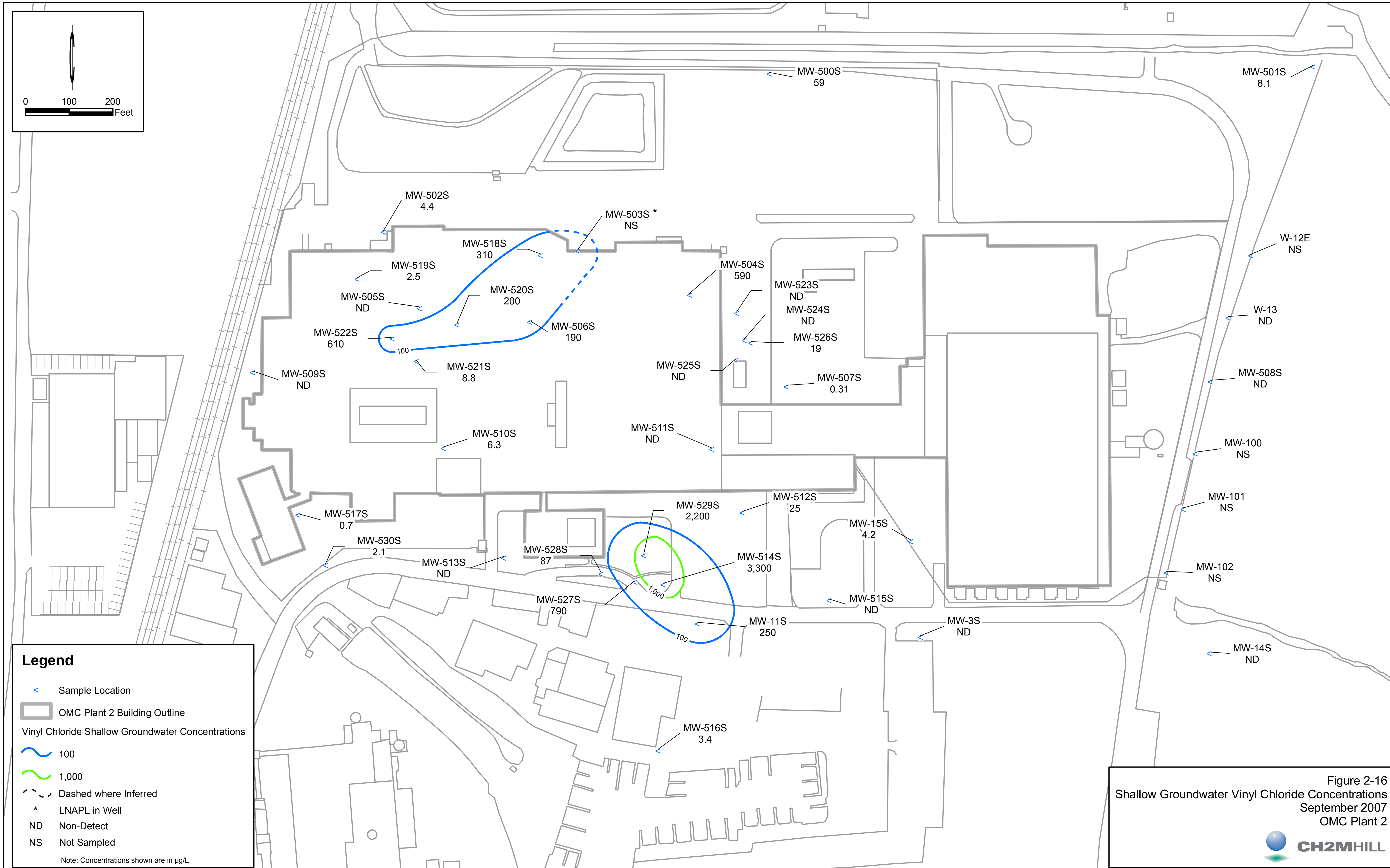


Figure 2-16
Shallow Groundwater Vinyl Chloride Concentrations
September 2007
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-17 - VINYL CHLORIDE SHALLOW SEPT 2007.MXD 1/22/2008 14:18:39

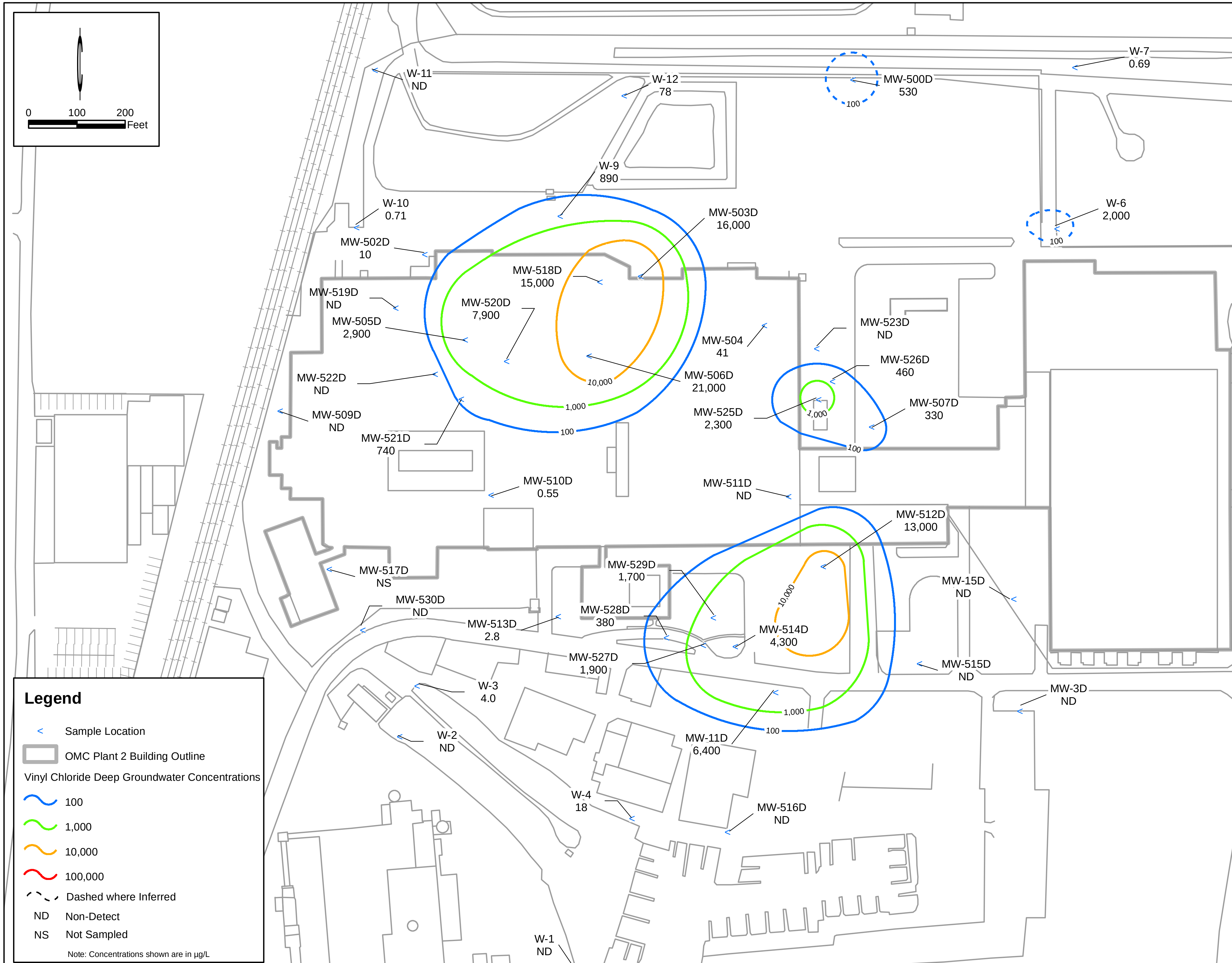


Figure 2-17
Deep Groundwater Vinyl Chloride Concentrations
September 2007
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\HYDRO INVESTIGATION JANUARY 2008\FIGURE 02-10 - VINYL CHLOIDE DEEP SEPT 2007.MXD 1/18/2008 15:26:20

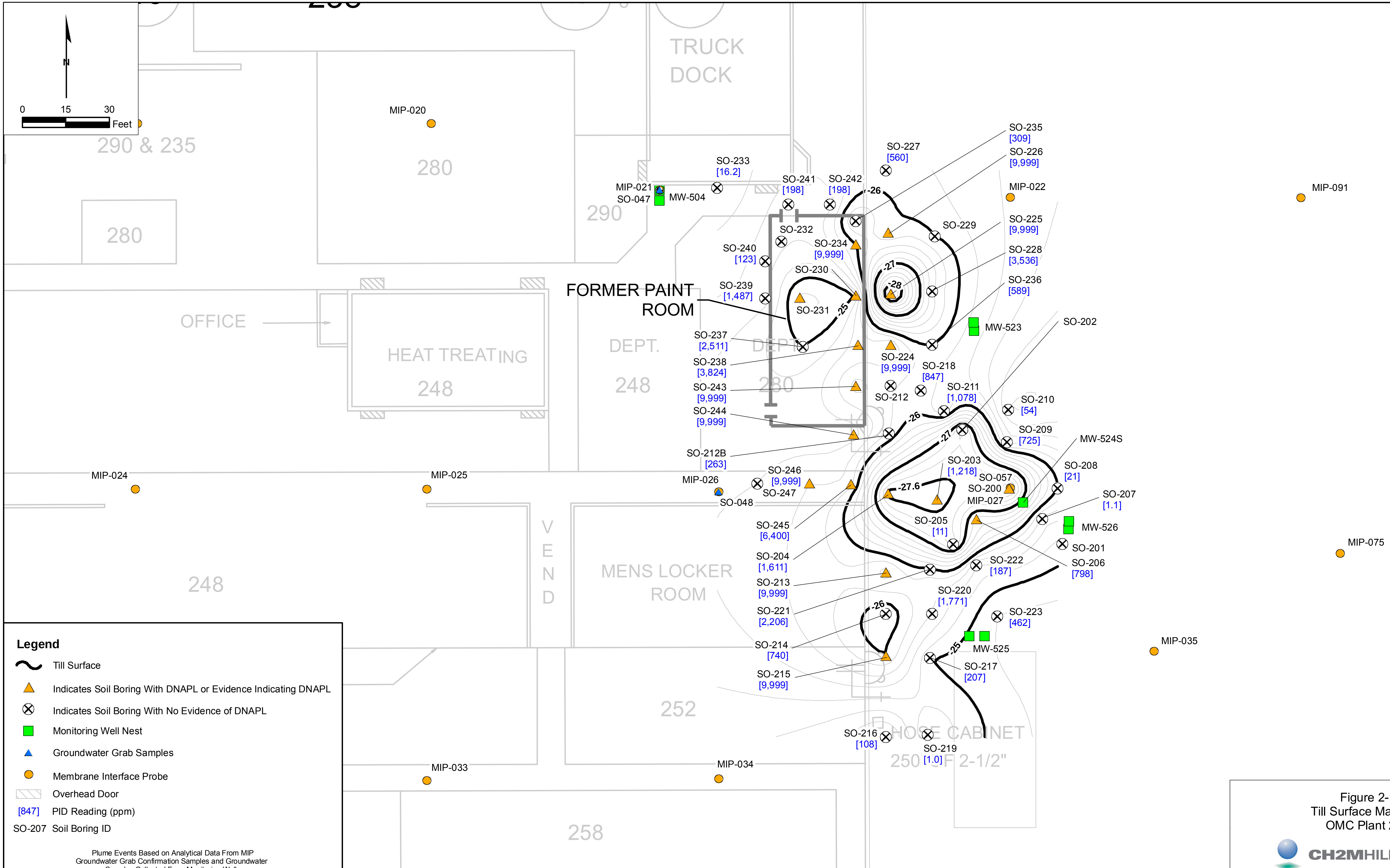


Figure 2-18
Till Surface Map
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\010507\FIGURE2-4_TILL_SURFACE_MAP.MXD 8/31/2007 11:01:47

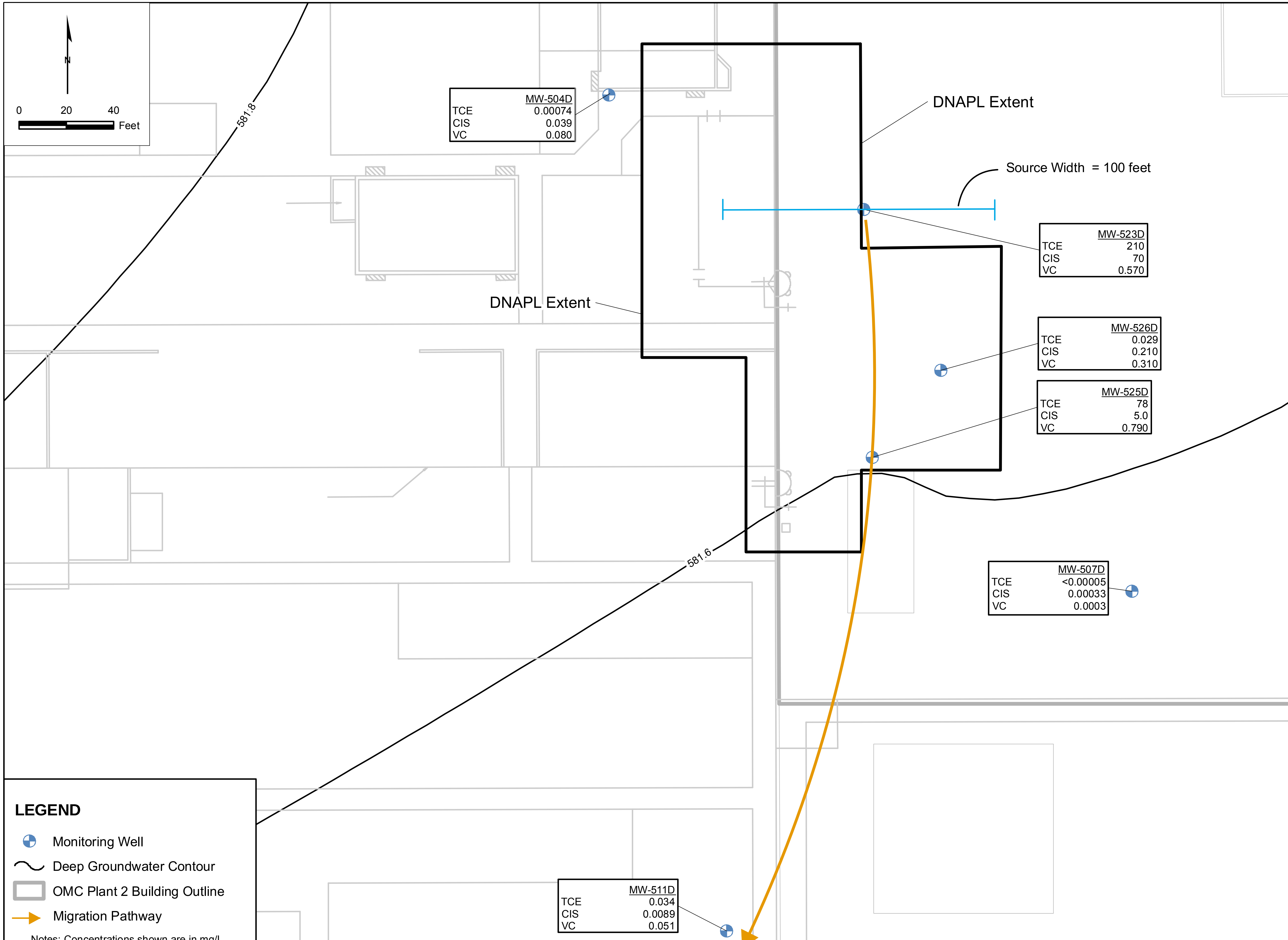


Figure 4-1
Source Zone 2 Model Extent
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE_3-1_SAMPLING_RESULTS.MXD 8/30/2007 16:39:31

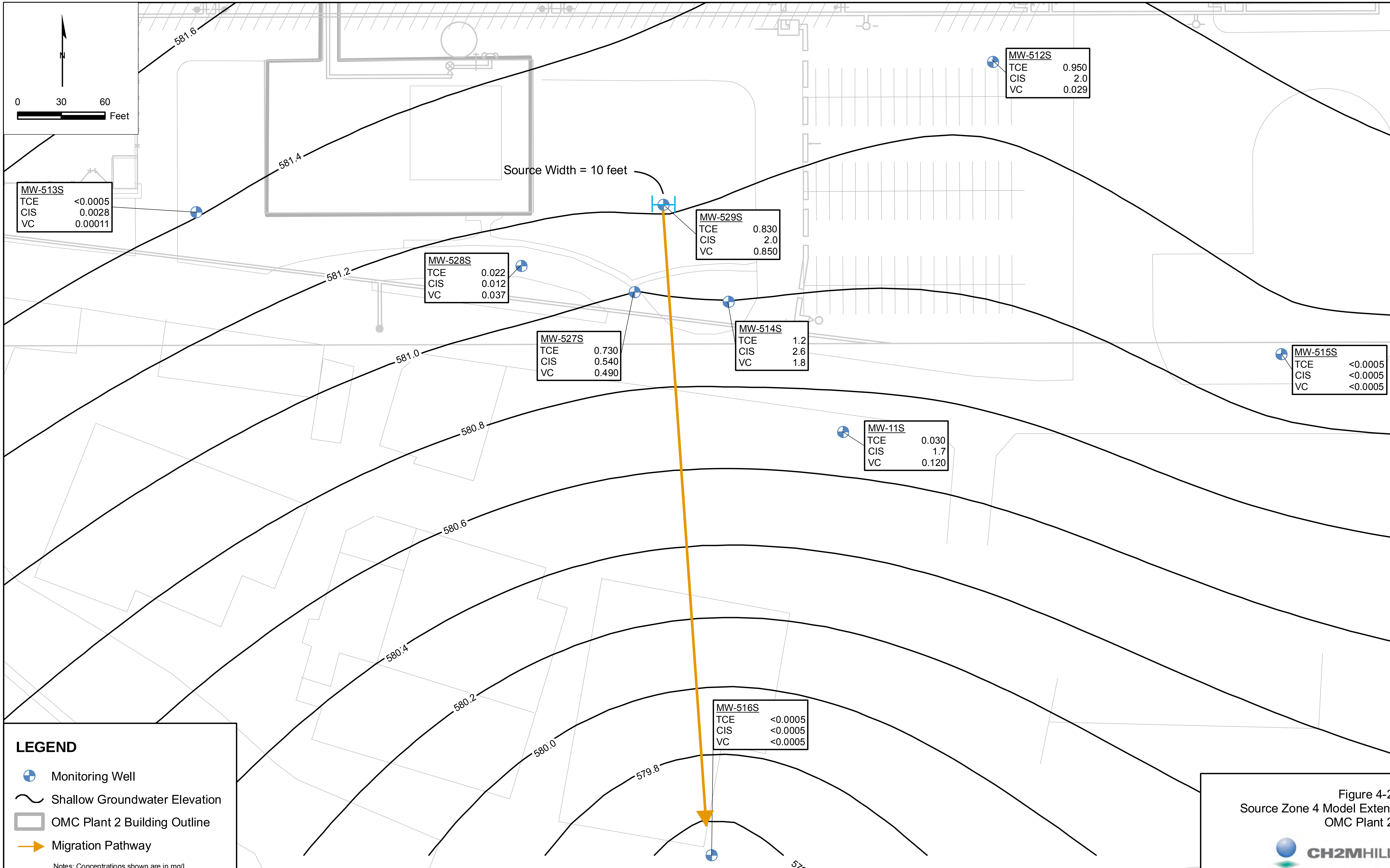


Figure 4-2
Source Zone 4 Model Extent
OMC Plant 2

CH2MHILL

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE_3-2_SAMPLING_RESULTS.MXD 8/30/2007 16:32:56

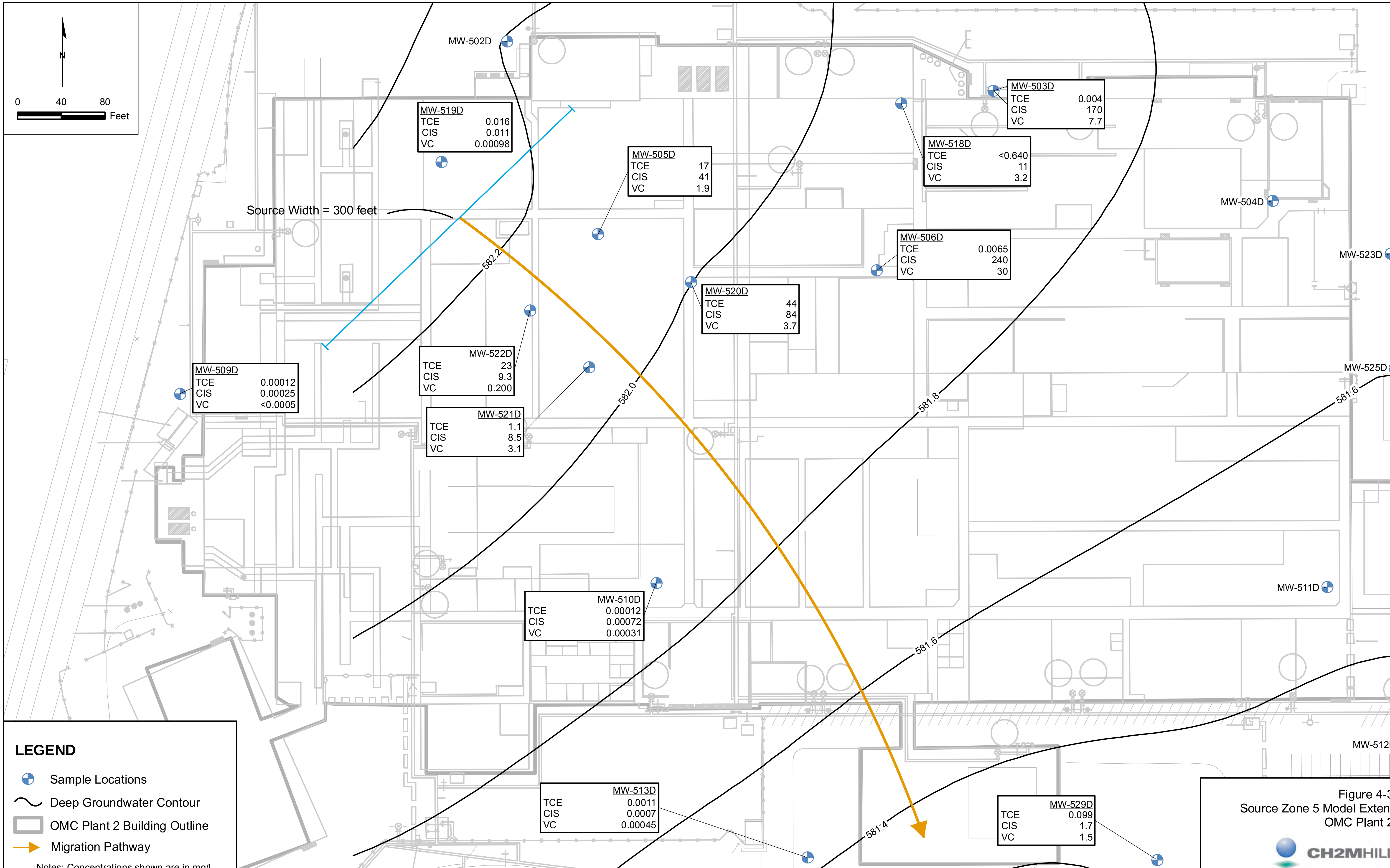


Figure 4-3
Source Zone 5 Model Extent
OMC Plant 2

MKE \\WAVE\PROJ\EPA\186305-OMC\GIS_DATA\MXDS\DATA EVALUATION MEMO JUNE 2007\FIGURE_3-3_SAMPLING_RESULTS.MXD 8/30/2007 16:36:18

Appendix A

Investigation Technical Memorandums

Hydrogeologic Investigation OMC Plant 2, Waukegan, Illinois WA No. 018-RICO-0528, Contract No. EP-S5-06-01

PREPARED FOR:	U.S. Environmental Protection Agency
PREPARED BY:	CH2M HILL
DATE:	August 31, 2007

Introduction

This memorandum documents the hydrogeologic investigation activities associated with the pilot test portion of the remedial investigation (RI) at the Outboard Marine Corporation (OMC) Plant 2 in Waukegan, Illinois. The investigation activities included installation and development of monitoring wells and permanent injection wells, measurement of groundwater levels, and baseline groundwater sampling. A dense nonaqueous phase liquid (DNAPL) investigation conducted on the east side of the metal working area is discussed in a separate technical memorandum. The hydrogeologic investigation was conducted between January 2 and March 22, 2007.

This memorandum includes the following:

- Description of field activities performed including locations, methods, and deviations from site-specific plans
- Summary of sample locations, depths, field measurements, and observations
- Boring logs and well construction diagrams, included as Attachments 1 and 2, respectively

Field Activities

The field activities conducted and their specific objectives, as discussed in the supplemental field sampling plan (SFSP; CH2M HILL 2006), included the following:

- Installing 25 monitoring wells (12 nested pairs and one individual well) in three separate areas (Figure 1).
- Installing 58 permanent injection wells in two source zones for the enhanced in situ bioremediation (EISB) pilot test. As part of this pilot test, sodium lactate and emulsified oil substrate (EOS™) will be injected into the aquifer in Source Zone 4 and Source Zone 5, respectively (Figures 2 and 3).
- Developing newly installed monitoring wells prior to groundwater sampling.

- Developing newly installed injection wells prior to amendment injection.
- Measuring groundwater levels from monitoring wells locations to verify current groundwater flow directions and rates.
- Collecting groundwater samples from monitoring wells locations to verify current groundwater quality conditions and characterize baseline conditions before the start of the pilot tests.

Innovative Probing Solutions (IPS) of Mt. Vernon, Illinois, performed well installation and development. CH2M HILL staff conducted groundwater level measurements and groundwater sampling.

Monitoring Well Installation

Locations

IPS installed 25 monitoring wells at 13 locations (15 wells outside the plant and 10 within the plant). Each location consists of a well nest including a shallow zone (0 to 10 feet) and a deep zone (20 to 30 feet) well with the exception of MW-524. The locations of the new and existing monitoring wells are shown on Figure 1.

Eight monitoring locations were initially identified in the SFSP. The proposed locations for these new wells were reexamined and modified based on the results of the DNAPL soil boring investigation and well installation borings. The modifications to the proposed monitoring well locations are as follows:

- Based on the extent of the DNAPL area, the EISB injection pilot test initially proposed for Source Zone 2 was moved to Source Zone 5. Monitoring wells were not installed in the building in Source Zone 2, as proposed in the SFSP; however, seven monitoring wells were installed east of the building in this area. These wells consisted of four nested pair locations. Monitoring well MW-524D was not installed because DNAPL was observed in the soil boring at the proposed screened interval.
- Four nested pairs of monitoring wells (shallow and deep) were installed in Source Zone 5 around the injection well array. One nest was located upgradient of the array; one nest was located within the array; and two nests were placed downgradient of the array.
- MW-518 S/D nested pair was installed west of the chip wringer room in the Plant 2 building.
- MW-530 S/D nested pair was installed to the south, downgradient of the former hazardous waste storage building after DNAPL was found in the deep monitoring well (MW-517D) adjacent to the building.
- No significant changes were made to the monitoring well locations in Source Zone 4.

Well Installation

Prior to monitoring well installation, soil samples at each location were continuously sampled from ground surface to the top of the till, as indicated by direct-push refusal. The direct-push sampling methodology is described in the field sampling plan (FSP; CH2M HILL 2004). Soil samples were collected using a Geoprobe® Macrocore sampler. The soil samples were logged using the American Society for Testing and Materials (ASTM) D-2487, Unified Soil Classification System and were screened for organic vapors using a photoionization detector (PID). The soil boring logs are provided in Attachment 1. In addition, soil was collected and submitted to Colorado State University Laboratories to be used for conducting a bench-scale treatability study for soil mixing.

The shallow and deep monitoring wells were installed using a 4.25-inch inside diameter (ID) hollow-stem auger method in accordance with the SFSP. The monitoring well construction information is summarized in Table 2, and the completion diagrams are provided in Attachment 2.

The deep monitoring wells were screened in overlying unconsolidated material above the till at depths ranging from 23.5 to 28.5 feet below ground surface (bgs). The deep monitoring wells were constructed of 2-inch ID, Schedule 40 polyvinyl chloride (PVC) casing and 5-foot PVC screens (0.010-inch machine slotted). Prior to well installation, 6 inches of coarse sand filter pack were placed in the bottom of the borings. The borings were filled with coarse sand filter pack to 1 foot above the top of the screen. An additional 1 foot of fine sand was placed on top of the coarse sand as a secondary filter pack. A 2-foot annular seal of 0.25-inch coated bentonite pellets was added. Lastly, the boring was filled to within 2 feet of the ground surface with bentonite grout via Tremie pipe or gravity fill. The final 2 feet of the boring were filled with concrete. Monitoring wells inside the building and Source Zone 4 were fitted with flush-mount casings, and the wells in Source Zone 2 were fitted with stickup casings. Monitoring wells installed in the DNAPL area (Source Zone 2) have stainless steel, continuous wire-wrapped screens with 0.010-inch slots. Monitoring well MW-522D also was fitted with at 2-inch-diameter stainless steel screen because of a sheen observed during development of the adjacent injection well IW-529. The deep wells were built in accordance with the SFSP.

The shallow monitoring wells were drilled to a depth of 7.5 to 15 feet bgs and screened in overlying unconsolidated material so that the center of the screen intersects the water table. Shallow monitoring wells also were constructed with 2-inch ID, Schedule 40 PVC casing and 5-foot PVC screens (0.010-inch machine slotted). At some locations, the boring was too shallow to necessitate grout, and the boring was filled to 2 feet bgs with coated betonite pellets. The shallow wells were built in accordance with the SFSP and in the same manner as the deep monitoring wells described above. Shallow monitoring well borings were not logged.

Injection Well Installation

Locations

Permanent injection wells were installed into volatile organic compound (VOC) Source Zones 4 and 5. Source Zone 4 is located northwest of the corporate building as shown on Figure 2. Source Zone 5 is located in the western park of the Plant 2 building as shown on Figure 3. A total of 58 injection wells were installed in the two EISB areas. Twenty injection wells were installed in Source Zone 4, which will be treated with sodium lactate, and 38 injection wells were installed in Source Zone 5, which will be treated with EOS™.

Due to conditions in the field, the locations of the two injection well arrays were altered from the SFSP (CH2M HILL 2006). The EOS™ injection well array was originally planned to be installed in Source Zone 2, in the eastern part of the Plant 2 building; however, the DNAPL soil boring investigation revealed a much more extensive DNAPL-impacted area than originally anticipated (CH2M HILL 2007). Because EISB is not effective when DNAPL is present in the aquifer, it was decided to move the EOS™ pilot test to Source Zone 5. The injection well array in Source Zone 5 consists of five parallel rows of wells (three rows of deep wells and two rows of shallow wells). The rows are oriented southwest to northeast, perpendicular to the northwest to southeast groundwater flow direction.

Only minor changes from the SFSP were made to the layout of the Source Zone 4 injection well array. The southernmost three rows of the array were shifted 7 feet north to avoid a sewer line believed to be located north of Seahorse Drive. The Waukegan Public Works Department estimated and marked the location of the sewer line. The array also was changed to have three rows of five deep injection wells and one row of five shallow injection wells. The original plan as proposed in the SFSP was designed to have a deep and a shallow row containing four injection wells each and a deep and shallow row consisting of six injection wells each. The rows are oriented west to east, perpendicular to the north to south groundwater flow direction.

Well Installation

The shallow and deep injection wells were installed using a 4.25-inch ID hollow-stem auger method in accordance with the SFSP. The injection well installation information is summarized in Table 2, and the well completion diagrams are provided in Attachment 2. The injection well borings were not logged.

The shallow injection wells are approximately 15 feet deep and screened in overlying unconsolidated material at approximately 9.5 to 14.5 feet bgs. These wells were constructed with 2-inch ID, Schedule 40 PVC casing and 5-foot stainless steel, continuous wire-wrapped screens with 0.010-inch slots. Prior to well installation, 6 inches of coarse sand filter pack were placed in bottom of the borings. The borings were filled with coarse sand filter pack to 1 foot above the top of the screen. Three to 6 inches of fine sand was placed as a secondary filter pack, and an annular seal of 1 foot of coated bentonite pellets was added. Finally, portland cement/bentonite mix grout was the added to the boring using a Tremie pipe apparatus to 2 feet bgs. The final 2 feet of the boring were filled with concrete. The injection wells were fitted with flush-mount casings. Locks were installed on the injection wells.

The deep injection wells were screened in overlying unconsolidated material above the till at depths ranging from 26 to 28 feet bgs. The deep injections wells were constructed in the same way as the shallow injection wells described above.

Well Development

New shallow and deep monitoring wells and injection wells were developed to remove fine-grained materials that may have settled in and around the well screen during installation, and to maximize the ability of the well to transmit representative portions of groundwater.

Well development of deep wells was completed using a three-phase mini-Monsoon pump attached to 1-inch, Schedule 40 PVC riser and discharge hose. Well development of shallow wells was completed using a two-phase Tempest pump attached to 1-inch, Schedule 40 PVC riser and discharge hose. Development was accomplished by surging the well screen with a submersible pump connected to the PVC pipe, followed by purging the suspended sediment. Water quality parameters such as pH, temperature, and specific conductance were periodically monitored during development to assess stabilization of these parameters. Well development continued until the well yielded relatively sediment-free water and/or the monitored water parameters had stabilized. A well development record was maintained by the onsite hydrogeologist to document the well development methods used, the estimated volume of water purged, and the results of the water quality parameters monitored. The final measured water quality parameters are presented in Table 3.

Fluids generated during well development activities were contained in a designated poly tank. Development water was subsequently transferred into bulk storage poly tanks. Equipment used during well development was decontaminated between monitoring well locations in accordance with FOP-17, *Decontamination of Drilling Rigs and Equipment*.

Water Level Measurements

Groundwater measurements were collected from the newly constructed and existing monitoring wells. Results of the water level measurements are found in Table 1.

Groundwater Sampling

Upon development of the wells, groundwater sampling was conducted using low-flow methods as described in the SFSP and in accordance with procedures outlined in the *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (USEPA 2002).

Groundwater was sampled from 52 of the existing 2-inch monitoring wells, and at the 23 newly installed monitoring wells. The following eight wells were not sampled:

- W-4 was frozen.
- MW-100 and MW-101 could not be located and were likely damaged during site demolition.
- MW-102 was damaged.
- MW-503S had light nonaqueous phase liquid (LNAPL) present in the well.
- MW-517D had DNAPL present in the well.
- MW-530S/D was underwater due to heavy rain.

A GeoPump™ peristaltic pump with 0.25-inch ID Teflon®-lined tubing was used for low-flow purging and sampling of monitoring wells. Field parameters, including depth to water, pH, specific conductance, conductivity, temperature, dissolved oxygen, and turbidity, were measured at 5-minute intervals using a YSI 6920 equipped with a flow-through cell. The flow rate also was measured at 5-minute intervals using a graduated cylinder. Groundwater samples were collected when field parameter readings had stabilized. Field parameter stabilization was determined using guidelines presented in the

U.S. Environmental Protection Agency (USEPA) publication *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (2002). A summary of the final field parameters is presented in Table 4.

Groundwater samples, including trip blanks, equipment blanks, duplicates, and matrix spike/matrix spike duplicate samples, were submitted to an analytical laboratory in USEPA's Contract Laboratory Program (CLP) to be analyzed for total and dissolved metals and cyanide, VOCs, semivolatile organic compounds, and polychlorinated biphenyls. Groundwater samples also were submitted to CT Laboratories in Baraboo, Wisconsin, to be analyzed for alkalinity, chloride, ethane, ethane, nitrate, nitrite, sulfate, sulfide, and total organic compounds.

References

ASTM Method D-5784-95.

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CH2M HILL , 2007. Technical Memorandum: Dense Nonaqueous Phase Liquid Investigation. March.

CH2M HILL. 2004. *Field Sampling Plan, OMC Plant 2, Waukegan, Illinois*. November.

USEPA. 2002. *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers.* Ground Water Forum Issue Paper by Douglas Yeskis and Bernard Zavalam. May.

Tables

TABLE 1

Well Data and Groundwater Elevation Table February 2007

OMC Plant 2

Location	Top of Casing Elevation (ft amsl)	Elevation Ground Surface (ft amsl)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Total Depth of Borehole (ft bgs)	Top of Screened Interval (ft amsl)	Bottom of Screened Interval (ft amsl)	Screen Midpoint Elevation (ft amsl)	Distance between Screen Midpoints	February 2007 Depth to Water (btoc)	February 2007 Total Depth (btoc)	February 2007 GW Elevation (ft amsl)	February 2007 vertical gradient*	Aquifer
W-3	585.70	583.80				583.80	583.80	583.80		4.13	24.15	581.57		Deep
W-4	582.60	582.92				582.92	582.92	582.92		not accessible	-	-		Deep
W-5	588.39	584.90				584.90	584.90	584.90		7.15	35.22	581.24		Deep
W-6	588.27	584.80				584.80	584.80	584.80		6.79	32.11	581.48		Deep
W-7	586.49	583.83				583.83	583.83	583.83		4.89	30.62	581.60		Deep
W-8	586.20	583.39				583.39	583.39	583.39		5.12	34.53	581.08		Deep
W-9	587.36	584.83				584.83	584.83	584.83		5.34	27.30	582.02		Deep
W-10	587.12	584.04				584.04	584.04	584.04		4.52	24.87	582.60		Deep
W-11	588.83	587.03				587.03	587.03	587.03		6.05	26.27	582.78		Deep
W-12	586.78	584.20				584.20	584.20	584.20		5.04	29.00	581.74		Deep
W-12E	584.89	582.81				582.81	582.81	582.81		not measured	-	-		Shallow
W-13	586.71	584.43				584.43	584.43	584.43		5.47	12.49	581.24		Shallow
MW-3D	587.41	584.88	22.80	27.80		562.08	557.08	559.58		5.71	NA	581.70		Deep
MW-3S	587.48	584.60				584.60	584.60	584.60	25.02	5.74	6.04	581.74	-0.002	Shallow
MW-11D	587.12	584.33	22.73	27.41		561.60	556.92	559.26		6.33	30.75	580.79		Deep
MW-11S	587.19	584.44				584.44	584.44	584.44	25.18	6.48	14.22	580.71	0.003	Shallow
MW-14D	583.19	583.47	25.75	30.75		557.72	552.72	555.22		2.05	29.78	581.14		Deep
MW-14S	583.06	583.44				583.44	583.44	583.44	28.22	2.93	11.32	580.13	0.036	Shallow
MW-15D	584.54	584.78	24.18	28.84		560.60	555.94	558.27		3.12	28.59	581.42		Deep
MW-15S	584.46	584.61				584.61	584.61	584.61	26.34	3.03	11.85	581.43	0.000	Shallow
MW-100	585.04	585.45				585.45	585.45	585.45		NA - well missing	-	-		Shallow
MW-101	585.04	585.16				585.16	585.16	585.16		NA - well missing	-	-		Shallow
MW-102	585.57	585.97				585.97	585.97	585.97		4.41	12.45	581.16		Shallow
MW-500D	586.19	583.65	20.50	25.50		563.15	558.15	560.65		4.46	27.10	581.73		Deep
MW-500S	586.18	583.71	1.50	6.50		582.21	577.21	579.71	19.06	4.47	9.06	581.71	0.001	Shallow
MW-501D	585.76	583.29	23.00	28.00		560.29	555.29	557.79		4.64	31.32	581.12		Deep
MW-501S	585.83	583.36	1.50	6.50		581.86	576.86	579.36	21.57	NA - well frozen	-		NA	Shallow
MW-502D	587.33	584.84	18.00	23.00		566.84	561.84	564.34		5.15	25.86	582.18		Deep
MW-502S	587.44	584.93	2.00	7.00		582.93	577.93	580.43	16.09	5.24	9.89	582.20	-0.001	Shallow
MW-503D	584.63	584.86	20.00	25.00		564.86	559.86	562.36		2.27	23.63	582.36		Deep
MW-503S	584.66	584.91	2.00	7.00		582.91	577.91	580.41	18.05	LNAPL	-		NA	Shallow
MW-504D	588.16	588.42	24.00	29.00		564.42	559.42	561.92		6.41	28.20	581.75		Deep
MW-504S	588.23	588.42	4.00	9.00		584.42	579.42	581.92	20.00	6.46	9.40	581.77	-0.0010	Shallow
MW-505D	587.97	588.36	22.00	27.00		566.36	561.36	563.86		5.81	25.40	582.16		Deep
MW-505S	588.13	588.36	4.00	9.00		584.36	579.36	581.86	18.00	5.98	8.75	582.15	0.001	Shallow
MW-506D	588.19	588.42	23.00	28.00		565.42	560.42	562.92		6.28	27.56	581.91		Deep
MW-506S	588.18	588.42	4.00	9.00		584.42	579.42	581.92	19.00	6.26	9.25	581.92	-0.001	Shallow
MW-507D	586.34	583.93	20.00	25.00		563.93	558.93	561.43		4.81	26.03	581.53		Deep
MW-507S	586.32	583.88	2.00	7.00		581.88	576.88	579.38	17.95	4.60	9.60	581.72	-0.011	Shallow
MW-508D	584.68	584.96	24.00	29.00		560.96	555.96	558.46		3.42	29.49	581.26		Deep
MW-508S	584.67	584.93	1.50	6.50		583.43	578.43	580.93	22.47	3.44	6.23	581.23	0.001	Shallow
MW-509D	584.19	584.41	14.50	19.50		569.91	564.91	567.41		1.05	NA	583.14		Deep
MW-509S	584.22	584.42	2.00	7.00		582.42	577.42	579.92	12.51	1.04	NA	583.18	-0.003	Shallow
MW-510D	588.07	588.33	22.00	27.00		566.33	561.33	563.83		6.20	27.31	581.87		Deep
MW-510S	588.05	588.33	4.00	9.00		584.33	579.33	581.83	18.00	6.19	9.43	581.86	0.001	Shallow

TABLE 1

Well Data and Groundwater Elevation Table February 2007

OMC Plant 2

Location	Top of Casing Elevation (ft amsl)	Elevation Ground Surface (ft amsl)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Total Depth of Borehole (ft bgs)	Top of Screened Interval (ft amsl)	Bottom of Screened Interval (ft amsl)	Screen Midpoint Elevation (ft amsl)	Distance between Screen Midpoints	February 2007 Depth to Water (btoc)	February 2007 Total Depth (btoc)	February 2007 GW Elevation (ft amsl)	February 2007 vertical gradient*	Aquifer
MW-511D	588.22	588.41	23.00	28.00		565.41	560.41	562.91		6.74	28.18	581.48		Deep
MW-511S	588.15	588.41	4.00	9.00		584.41	579.41	581.91	19.00	6.69	9.27	581.46	0.001	Shallow
MW-512D	584.60	584.86	20.00	25.00		564.86	559.86	562.36		3.30	25.41	581.30		Deep
MW-512S	584.56	584.83	2.50	7.50		582.33	577.33	579.83	17.47	3.30	7.31	581.26	0.002	Shallow
MW-513D	585.29	585.54	20.50	25.00		565.04	560.54	562.79		3.85	23.30	581.44		Deep
MW-513S	585.23	585.44	2.50	7.50		582.94	577.94	580.44	17.65	3.82	7.62	581.41	0.002	Shallow
MW-514D	584.70	584.92	20.00	25.00		564.92	559.92	562.42		3.41	24.92	581.29		Deep
MW-514S	584.70	584.70	2.50	7.50		582.20	577.20	579.70	17.28	3.70	6.93	581.00	0.017	Shallow
MW-515D	583.90	583.88	21.00	26.00		562.88	557.88	560.38		2.38	26.21	581.52		Deep
MW-515S	583.71	583.97	3.00	8.00		580.97	575.97	578.47	18.09	2.57	7.87	581.14	0.021	Shallow
MW-516D	583.78	584.04	20.00	25.00		564.04	559.04	561.54		4.35	25.40	579.43		Deep
MW-516S	583.80	584.08	3.00	8.00		581.08	576.08	578.58	17.04	4.31	8.27	579.49	-0.004	Shallow
MW-517D	586.64	584.19	15.00	20.00		569.19	564.19	566.69		4.29	22.70	582.35		Deep
MW-517S	586.64	584.18	2.50	7.50		581.68	576.68	579.18	12.49	4.42	9.72	582.22	0.010	Shallow
MW-518D	588.00	588.34	21.61	26.61	27.31	566.73	561.73	564.23		6.06	26.81	581.94		Deep
MW-518S	587.95	588.33	5.38	10.38	11.08	582.95	577.95	580.45	16.22	5.01	10.58	582.94	-0.062	Shallow
MW-519D	587.84	588.16	20.85	25.85	26.55	567.31	562.31	564.81		5.54	26.05	582.30		Deep
MW-519S	587.82	588.17	9.69	14.69	15.39	578.48	573.48	575.98	11.17	5.52	14.89	582.30	0.000	Shallow
MW-520D	587.81	588.13	20.94	25.94	26.64	567.19	562.19	564.69		5.81	26.14	582.00		Deep
MW-520S	587.67	588.10	10.00	15.00	15.70	578.10	573.10	575.60	10.91	5.67	15.20	582.00	0.000	Shallow
MW-521D	588.08	588.33	20.36	25.36	26.06	567.97	562.97	565.47		6.04	25.56	582.04		Deep
MW-521S	587.90	588.33	9.98	14.98	15.68	578.35	573.35	575.85	10.38	5.84	15.18	582.06	-0.001	Shallow
MW-522D	588.06	588.33	20.83	25.83	26.53	567.50	562.50	565.00		5.93	26.03	582.13		Deep
MW-522S	588.04	588.35	10.15	15.15	15.85	578.20	573.20	575.70	10.70	5.81	15.35	582.23	-0.010	Shallow
MW-523D	588.14	585.55	23.25	28.25	28.95	562.30	557.30	559.80		6.35	28.45	581.79		Deep
MW-523S	588.18	585.55	3.60	8.60	9.30	581.95	576.95	579.45	19.66	6.53	8.80	581.65	0.007	Shallow
MW-524D	Not installed - DNAPL									NA	NA			Deep
MW-524S	587.99	585.43	4.55	9.55	10.25	580.88	575.88	578.38	578.38	6.38	9.75	581.61	NA	Shallow
MW-525D	588.18	585.62	23.83	28.83	29.53	561.79	556.79	559.29		6.58	29.03	581.60		Deep
MW-525S	588.32	585.75	4.65	9.65	10.35	581.10	576.10	578.60	19.31	6.74	9.85	581.58	0.001	Shallow
MW-526D	587.90	585.13	23.66	28.66	29.36	561.47	556.47	558.97		6.17	28.86	581.73		Deep
MW-526S	587.89	585.14	6.37	11.37	12.07	578.77	573.77	576.27	17.30	6.17	11.57	581.72	0.001	Shallow
MW-527D	584.31	584.57	21.66	26.66	27.36	562.91	557.91	560.41		3.78	26.86	580.53		Deep
MW-527S	584.29	584.49	2.48	7.48	8.18	582.01	577.01	579.51	19.10	3.29	7.68	581.00	-0.024	Shallow
MW-528D	586.40	586.62	20.61	25.61	26.31	566.01	561.01	563.51		5.30	25.81	581.10		Deep
MW-528S	586.46	586.76	4.93	9.93	10.63	581.83	576.83	579.33	15.82	5.33	10.13	581.13	-0.002	Shallow
MW-529D	586.16	586.51	23.24	28.24	28.94	563.27	558.27	560.77		4.91	28.44	581.25		Deep
MW-529S	586.06	586.46	4.60	9.60	10.30	581.86	576.86	579.36	18.58	4.83	9.80	581.23	0.001	Shallow
MW-530D	NA		16.68	21.68	22.38					1.13	21.88			Deep
MW-530S	583.66	583.85	2.04	7.04	7.74	581.81	576.81	579.31	579.31	1.04	7.24	582.62		Shallow

Survey coordinates are NAD 1983 State Plane Illinois East FIPS 1201 Feet

ft amsl = feet above mean sea level

ft btoc = feet below top of casing

*Negative value for vertical gradient denotes downward direction

TABLE 2
Monitoring and Injection Well Construction Table
OMC Plant 2

Well ID	Well diameter	Surface Completion	Date Installed	Total Depth (ft bgs)	Total Depth (ft btoc)	Screened Interval (ft bgs)	Filter Pack (ft bgs)	Annular Seal (ft bgs)	Bentonite/ Bentonite Slurry (ft bgs)	Initial Water Level (ft btoc)	Soil Boring Reference ID	Screened Zone Material	Surface Completion
Chemical Storage Area													
MW-530S	2" SCH 40 PVC	Flush Mount	2/28/2007	15		9.5-14.5	7.5-15.0	5.5-7.5	2.0-5.5	2.58	MW-530D	fine to coarse sand	X
MW-530D	2" SCH 40 PVC	Flush Mount	3/5/2007	23.5		18.0-23.0	16.0–23.5	14.0-16.0	2.0-14.0	2.55	MW-530D	fine sand	X
Parking Lot between Old Die Cast Area and New Die Cast Area													
MW-523S	2" SCH 40 PVC	Stick-up	1/10/2007	8.5	8.80	3.0-8.0	1.7-8.5	1.2-1.7	1.0-1.2	6.53	MW-523D	medium to fine sand, sandy gravel	X
MW-523D	2" SCH 40 PVC	Stick-up	2/20/2007	26.5	28.45	21.0-26.0	19.0-26.5	17.0-19.0	2.0-17.0	5.45	MW-523D	silty fine sand, fine sand, silty clay, silty gravel	X
MW-524S	2" SCH 40 PVC	Stick-up	1/10/2007	8.5	9.75	3.0-8.0	1.8-8.5	1.2-1.8	1.0-1.2	6.41	MW-524D	medium to fine sand	X
MW-524D	Not Installed due to DNAPL												
MW-525S	2" SCH 40 PVC	Stick-up	1/10/2007	8.5	9.85	3.0-8.0	1.8-8.5	1.2-1.8	1.0-1.2	6.74	MW-525D	fine to coarse sand	X
MW-525D	2" SCH 40 PVC	Stick-up	2/12/2007	26	29.03	20.5-25.5	18.5-26.0	16.5-18.5	?-16.5	6.58	MW-525D	fine sand, silty, sandy gravel	X
MW-526S	2" SCH 40 PVC	Stick-up	1/31/2007	8.5	11.57	3.0-8.0	2.0-8.5	1.0-2.0	None	6.17	MW-526D	sand, gravelly sand	X
MW-526D	2" SCH 40 PVC	Stick-up	1/26/2007	27	28.86	21.5-26.5	19.5-27.0	17.5-19.5	2.0-17.5		MW-526D	fine sand, sandy gravel, clay	X
Near Corporate Offices													
MW-527S	2" SCH 40 PVC	Flush Mount	2/1/2007	11	7.68	5.5-10.5	3.5-11.0	1.5-3.5	?-1.5	3.36	MW-527D	medium to coarse sand, gravel	X
MW-527D	2" SCH 40 PVC	Flush Mount	2/19/2007	26.5	26.86	21.0-26.0	19.0-26.5	17.0-19.0	2.0-17.0	3.41	MW-527D	medium sand	X
MW-528S	2" SCH 40 PVC	Flush Mount	1/31/2007	11	10.13	5.0-10.0	4.0-11.0	2.0-4.0	?-2.0	5.23	MW-528D	medium to coarse sand	X
MW-528D	2" SCH 40 PVC	Flush Mount	2/1/2007	28	25.81	22.5-27.5	20.5-28	18.5-20.5	2.0-18.5	5.22	MW-528D	medium sand	X
MW-529S	2" SCH 40 PVC	Flush Mount	2/1/2007	11	9.80	5.5-10.5	3.5-11.0	1.5-3.5	?-1.5	5.04	MW-529D		
MW-529D	2" SCH 40 PVC	Flush Mount	2/19/2007	28.5	28.44	23.0-28.0	21.0-28.5	19.0-21.0	2.0-19.0	5.01	MW-529D		
Injection Wells													
IW-400	2" SCH 40 PVC	Flush Mount	2/26/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	4.60	NA	NA	X
IW-401	2" SCH 40 PVC	Flush Mount	2/21/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	3.40	NA	NA	X
IW-402	2" SCH 40 PVC	Flush Mount	2/21/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	3.62	NA	NA	X
IW-403	2" SCH 40 PVC	Flush Mount	2/21/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	3.81	NA	NA	X
IW-404	2" SCH 40 PVC	Flush Mount	2/22/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	3.00	NA	NA	X
IW-405	2" SCH 40 PVC	Flush Mount	2/26/2007							4.62	NA	NA	X
IW-406	2" SCH 40 PVC	Flush Mount	2/23/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	4.41	NA	NA	X
IW-407	2" SCH 40 PVC	Flush Mount	2/23/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	4.06	NA	NA	X
IW-408	2" SCH 40 PVC	Flush Mount	2/20/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	3.94	NA	NA	X
IW-409	2" SCH 40 PVC	Flush Mount	2/21/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	3.52	NA	NA	X
IW-410	2" SCH 40 PVC	Flush Mount	2/22/2007	28		22.5-27.5	21.0-28.0	20.0-21.0	2.0-20.0	4.42	NA	NA	X
IW-411	2" SCH 40 PVC	Flush Mount	2/22/2007	28		22.5-27.5	21.0-28.0	20.0-21.0	2.0-20.0	4.53	NA	NA	X
IW-412	2" SCH 40 PVC	Flush Mount	2/21/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	3.90	NA	NA	X
IW-413	2" SCH 40 PVC	Flush Mount	2/21/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	3.42	NA	NA	X
IW-414	2" SCH 40 PVC	Flush Mount	2/22/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	2.42	NA	NA	X
IW-415	2" SCH 40 PVC	Flush Mount	2/27/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	3.92	NA	NA	X
IW-416	2" SCH 40 PVC	Flush Mount	2/26/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	4.21	NA	NA	X
IW-417	2" SCH 40 PVC	Flush Mount	2/27/2007	27.5		22.0-27.0	20.5-27.5	19.5-20.5	2.0-19.5	4.11	NA	NA	X
IW-418	2" SCH 40 PVC	Flush Mount	2/28/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	3.82	NA	NA	X
IW-419	2" SCH 40 PVC	Flush Mount	2/28/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	5.56	NA	NA	X
Within the Plant 2 Building													
MW-518S	2" SCH 40 PVC	Flush Mount	1/9/2007	10.5	10.58	5.0-10.0	3.5-10.5	2.0-3.5	?-2.0	5.88	MW-518D	fine to coarse sand	X
MW-518D	2" SCH 40 PVC	Flush Mount	1/30/2007	27.5	26.81	22.0–27.0	20.0–27.5	18.0–20.0	2.0–18.0	5.88	MW-518D	fine sand	X
MW-519S	2" SCH 40 PVC	Flush Mount	1/5/2007	15	14.89	9.5-14.5	7.5-14.5	5.5-7.5	2.0-5.5	5.71	MW-519D	fine sand	X
MW-519D	2" SCH 40 PVC	Flush Mount	2/13/2007	26.5	26.05	21.0-26.0	19.0-26.5	17.0-19.0	2.0-19.0	5.71	MW-519D	fine sand, gravel	X
MW-520S	2" SCH 40 PVC	Flush Mount	1/8/2007	15	15.20	9.5-14.5	7.5-15.0	5.5-7.5	1.0-5.5	5.45	MW-520D	fine to medium sand	X
MW-520D	2" SCH 40 PVC	Flush Mount	1/30/2007	27	26.14	21.5-26.5	19.5-27.0	17.5-19.5	2.0-17.5	5.81	MW-520D	fine sand, gravel	X
MW-521S	2" SCH 40 PVC	Flush Mount	1/8/2007	15	15.18	9.5-14.5	7.5-15.0	5.5-7.5	2.0-5.5	5.57	MW-521D	fine to coarse sand, gravel	X
MW-521D	2" SCH 40 PVC	Flush Mount	1/25/2007	26	25.56	20.5-25.5	18.5-26.0	16.5-18.5	2.0-16.5	6.58	MW-521D	fine to medium sand, sandy gravel	X
MW-522S	2" SCH 40 PVC	Flush Mount	1/8/2007	15	15.35	9.5-14.5	7.5-14.5	5.5-7.5	2.0-5.5	5.71	MW-522D	medium to fine sand	X
MW-522D	2" SCH 40 PVC	Flush Mount	1/25/2007	26.5	26.03	21.0-26.0	19.0-26.5	17.0-19.0	2.0-19.0	5.93	MW-522D	fine sand, gravelly sand	X

TABLE 2
Monitoring and Injection Well Construction Table
OMC Plant 2

Well ID	Well diameter	Surface Completion	Date Installed	Total Depth (ft bgs)	Total Depth (ft btoc)	Screened Interval (ft bgs)	Filter Pack (ft bgs)	Annular Seal (ft bgs)	Bentonite/ Bentonite Slurry (ft bgs)	Initial Water Level (ft btoc)	Soil Boring Reference ID	Screened Zone Material	Surface Completion
Injection Wells													
IW-500	2" SCH 40 PVC	Flush Mount	1/4/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.78	NA	NA	X
IW-501	2" SCH 40 PVC	Flush Mount	1/4/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.66	NA	NA	X
IW-502	2" SCH 40 PVC	Flush Mount	1/4/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	-	NA	NA	X
IW-503	2" SCH 40 PVC	Flush Mount	1/4/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	-	NA	NA	X
IW-504	2" SCH 40 PVC	Flush Mount	1/17/2007	27		21.5-26.5	20.2-27.0	19.2-20.2	2.0-19.2	5.59	NA	NA	X
IW-505	2" SCH 40 PVC	Flush Mount	1/18/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	5.68	NA	NA	X
IW-506	2" SCH 40 PVC	Flush Mount	1/17/2007	27		21.5-26.5	20.2-27.0	19.2-20.2	2.0-19.2	5.68	NA	NA	X
IW-507	2" SCH 40 PVC	Flush Mount	1/16/2007	26.5		21.0-26.0	19.7-26.5	18.7-19.7	2.0-18.7	5.81	NA	NA	X
IW-508	2" SCH 40 PVC	Flush Mount	1/18/2007	27		21.5-26.5	20.0-27.0	19.0-20.0	2.0-19.0	-	NA	NA	X
IW-509	2" SCH 40 PVC	Flush Mount	1/18-19/2007	26.5		21.0-26.0	19.5-26.5	18.5-19.5	2.0-18.5	5.64	NA	NA	X
IW-510	2" SCH 40 PVC	Flush Mount	1/19/2007	26		20.5-25.5	19.5-26.0	18.5-19.5	2.0-18.5	5.55	NA	NA	X
IW-511	2" SCH 40 PVC	Flush Mount	1/2/2007	26.5		21.0-26.0	19.5-26.5	18.5-19.5	2.0-18.5	5.72	NA	NA	X
IW-512	2" SCH 40 PVC	Flush Mount	1/22/2007	26		20.5-25.5	19.0-26.0	18.0-19.0	2.0-18.0	5.78	NA	NA	X
IW-513	2" SCH 40 PVC	Flush Mount	1/5/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.56	NA	NA	X
IW-514	2" SCH 40 PVC	Flush Mount	1/5/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.63	NA	NA	X
IW-515	2" SCH 40 PVC	Flush Mount	1/2/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.25	NA	NA	X
IW-516	2" SCH 40 PVC	Flush Mount	1/2/2007	15		9.5-14.5	8.0-15.0	7.0-8.0	2.0-7.0	5.32	NA	NA	X
IW-517	2" SCH 40 PVC	Flush Mount	1/3/2007	15		9.5-14.5	8.5-15.0	7.5-8.5	2.0-7.5	5.46	NA	NA	X
IW-518	2" SCH 40 PVC	Flush Mount	1/3/2007	15		9.5-14.5	8.5-15.0	7.5-8.5	2.0-7.5	5.40	NA	NA	X
IW-519	2" SCH 40 PVC	Flush Mount	1/3/2007	15		9.5-14.5	8.5-15.0	7.5-8.5	2.0-7.5	5.51	NA	NA	X
IW-520	2" SCH 40 PVC	Flush Mount	1/3/2007	15		9.5-14.5	8.5-15.0	7.5-8.5	2.0-7.5	5.56	NA	NA	X
IW-521	2" SCH 40 PVC	Flush Mount	1/3/2007	15		9.5-14.5	8.5-15.0	7.5-8.5	2.0-7.5	5.49	NA	NA	X
IW-522	2" SCH 40 PVC	Flush Mount	1/15/2007	26.5		21.0-26.0	19.7-26.5	18.7-19.7	2.0-18.7	5.74	NA	NA	X
IW-523	2" SCH 40 PVC	Flush Mount	1/16/2007	26.5		21.0-26.0	19.7-26.5	18.7-19.8	2.0-18.8	5.58	NA	NA	X
IW-524	2" SCH 40 PVC	Flush Mount	1/2/2007	28		22.5-27.5	21.3-28.0	20.0-21.3	2.0-20.0	5.35	NA	NA	X
IW-525	2" SCH 40 PVC	Flush Mount	1/2/2007	28		22.5-27.5	21.0-28.0	20.0-21.0	2.0-20.0	5.41	NA	NA	X
IW-526	2" SCH 40 PVC	Flush Mount	1/3/2007	27		21.5-25.5	20.5-27.0	19.5-20.5	2.0-19.5	5.45	NA	NA	X
IW-527	2" SCH 40 PVC	Flush Mount	1/3/2007	26		20.5-25.5	19.5-26.0	18.5-19.5	2.0-18.5	-	NA	NA	X
IW-528	2" SCH 40 PVC	Flush Mount	1/4/2007	26		20.5-25.5	19.5-26.0	18.5-19.5	2.0-18.5	5.47	NA	NA	X
IW-529	2" SCH 40 PVC	Flush Mount	1/5/2007	26		20.5-25.5	19.5-26.0	18.5-19.5	2.0-18.5	5.42	NA	NA	X
IW-530	2" SCH 40 PVC	Flush Mount	1/8/2007	27.5		22.0-27.0	20.7-27.5	19.7-20.7	2.0-19.7	5.51	NA	NA	X
IW-531	2" SCH 40 PVC	Flush Mount	1/9/2007	26		20.5-25.5	19.2-26.0	18.2-19.2	2.0-18.2	5.52	NA	NA	X
IW-532	2" SCH 40 PVC	Flush Mount	1/15/2007	27		21.5-26.5	20.7-27	19.7-20.7	2.0-19.7	5.54	NA	NA	X
IW-533	2" SCH 40 PVC	Flush Mount	1/12/2007	27.6		22.1-27.1	19.8-27.6	18.8-19.8	2.0-18.8	5.55	NA	NA	X
IW-534	2" SCH 40 PVC	Flush Mount	1/11/2007	26.6		21.1-26.6	19.8-26.6	18.8-19.8	2.0-18.8	5.57	NA	NA	X
IW-535	2" SCH 40 PVC	Flush Mount	1/11/2007	27		21.5-26.5	20.2-27.0	19.2-20.2	2.0-19.2	5.72	NA	NA	X
IW-536	2" SCH 40 PVC	Flush Mount	1/10/2007	26.5		21.0-26.0	19.8-26.5	18.8-19.8	2.0-18.8	5.54	NA	NA	X
IW-537	2" SCH 40 PVC	Flush Mount	1/10/2007	26.5		21.0-26.0	19.7-26.5	18.7-19.7	2.0-18.7	5.55	NA	NA	X

a. ft bgs = feet below ground surface.
b. ft btoc = feet below top of casing
c. NA = not available
d. "S" suffix for well ID indicates shallow monitoring well
e. "D" suffix for well ID indicates deep monitoring well
f. SCH = Schedule.
g. PVC = PolyVinyl Chloride.
h. DNAPL = Dense Non-Aqueous Phase Liquid

TABLE 3
Monitoring and Injection Well Development Table
OMC Plant 2

Well ID	Date Developed	Initial DTW (ft btoc)	Ending Parameters: Turbidity (NTU)	Temp (C)	pH	Conductance (uS/cm)	Remarks	Development Method
Chemical Storage Area								
MW-530S	3/8/2007	2.58	0.8	3.92	7.48	595	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-530D	3/8/2007	2.55	2.7	11.48	7.15	1,348	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Parking Lot between Old Die Cast Area and New Die Cast Area								
MW-523S	2/14/2007	6.53	1.6	4.91	7.87	1051	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-523D	2/21/2007	5.45	2.84	13.16	6.97	1813	Turbid, odor, PID 579 ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-524S	2/14/2007	6.41	3.57	4.15	7.82	1120	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-524D							Not installed due to DNAPL	
MW-525S	2/14/2007	6.74	1.01	4.47	7.54	932	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-525D	2/14/2007	6.58	6.3	11.11	7.12	3109	Solvent odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-526S	2/14/2007	6.17	3.33	5.06	7.85	1309	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-526D	2/14/2007	6.17	4.33	11.45	7.24	3478	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Near Corporate Offices								
MW-527S	2/20/2007	3.36	1.33	5.53	7.14	1327	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-527D	2/20/2007	3.41	1.89	11.95	7.18	2513	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-528S	2/19/2007	5.23	3.69	6.64	7.21	1231	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-528D	2/19/2007	5.22	6.76	12.83	7.24	3312	Turbid, sediment present	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-529S	2/20/2007	5.04	0.91	7.79	7.17	1333	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-529D	2/20/2007	5.01	2.97	12.19	7.23	2182	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Injection Wells								
IW-400	3/2/2007	4.60	1.45	8.82	7.08	1110	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-401	3/2/2007	3.40	0.55	9.25	7.11	1208	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-402	3/1/2007	3.62	1.16	9.4	7.20	1462	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-403	2/26/2007	3.81	2.03	10.39	7.13	1449	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-404	2/26/2007	3.00	4.2	10.67	7.18	1232	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-405	3/2/2007	4.62	12.3	11.14	6.93	2324	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-406	3/2/2007	4.41	3.55	11.32	6.95	2093	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-407	3/1/2007	4.06	3.88	12.16	7.35	1935	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-408	2/26/2007	3.94	7.97	11.25	7.23	1421	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-409	2/26/2007	3.52	2.44	12.77	7.18	1062	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-410	3/2/2007	4.42	2.83	11.25	6.99	2097	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-411	3/1/2007	4.53	7.87	12.1	7.32	2142	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-412	3/1/2007	3.90	2.31	11.96	7.30	1540	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-413	2/27/2007	3.42	2.57	12.05	7.37	1432	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-414	2/27/2007	2.42	2.92	12.46	7.38	1316	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-415	3/2/2007	3.92	3.09	11.2	7.01	2181	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-416	3/7/2007	4.21	5.01	11.77	7.12	1853	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-417	3/7/2007	4.11	6.69	11.51	7.18	1410	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-418	3/7/2007	3.82	6.76	11.8	7.45	1187	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-419	3/7/2007	5.56	1.9	12.13	7.25	1232	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

TABLE 3
Monitoring and Injection Well Development Table
OMC Plant 2

			Ending Parameters					
Well ID	Date Developed	Initial DTW (ft btoc)	Turbidity (NTU)	Temp (C)	pH	Conductance (uS/cm)	Remarks	Development Method
Larson Marine Property - Near Slip 4								
Within the Plant 2 Building								
MW-518S	2/13/2007	5.88	2.19	10.15	7.31	816	Oily sheen	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-518D	2/13/2007	5.88	2.64	13.52	7.06	2567	Oily sheen	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-519S	2/14/2007	5.71	3.95	11.12	7.24	2603	Sulfur odor	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-519D	2/14/2007	5.71	3.51	12.43	7.12	2597	slight solvent-like odor, sheen	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-520S	1/8/2007	5.45	6	13.55	7.25	873	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-520D	2/13/2007	5.81	1.46	14.63	7.10	1458	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-521S	1/22/2007	5.57	-	13.22	7.40	1126	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-521D	2/13/2007	6.58	5.1	14.1	7.26	1555	Sulfur odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
MW-522S	1/22/2007	5.71	11.4	13.14	7.39	1172	Clear, sulfur odor	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
MW-522D	2/13/2007	5.93	7.1	13.56	7.22	1616	Solvent-like odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Injection Wells								
IW-500	2/14/2007	5.78	5.25	11.11	7.30	2895	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-501	2/15/2007	5.66	1.9	11.59	7.27	1858	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-502	1/30/2007	-	5	12.45	7.31	1098	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-503	1/30/2007	-	4	12.27	7.40	1014	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-504	1/25/2007	5.59	9	14.13	6.96	1682	Clear, slight odor, PID - 38ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-505	1/25/2007	5.68	4	14.19	6.96	1486	Clear, slight odor, PID - 26ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-506	1/25/2007	5.68	8	14.16	7.00	1275	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-507	1/25/2007	5.81	7	14.11	7.13	1139	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-508	1/30/2007	-	8	14.25	7.22	1076	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-509	1/30/2007	5.64	5	14.12	7.25	1053	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-510	1/30/2007	5.55	5	14.03	7.20	1090	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-511	2/15/2007	5.72	6.6	12.07	7.17	2080	Solvent odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-512	2/15/2007	5.78	14.8	12.26	7.28	2194	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-513	1/25/2007	5.56	1	12.82	7.12	929	Clear, no odor	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-514	1/25/2007	5.63	1	13.09	7.27	870	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-515	1/18/2007	5.25	5.2	13.48	7.24	856	Clear, slight odor	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-516	1/18/2007	5.32	2.42	13.55	7.30	871	Clear, very slight odor	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-517	1/18/2007	5.46	5.4	13.36	7.40	870	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-518	1/19/2007	5.40	3.32	13.37	7.22	1028	Clear, PID normal	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-519	1/19/2007	5.51	4.55	13.45	7.24	1142	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-520	1/19/2007	5.56	1.2	13.28	7.26	1180	None	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-521	1/22/2007	5.49	-	12.94	7.42	1236	Clear	2-phase Tempest Pumps attached to 1" SCH 40 PVC riser
IW-522	1/25/2007	5.74	2	14.51	6.84	1704	Clear, slight odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-523	1/25/2007	5.58	3	14.5	6.82	1695	Clear, slight odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-524	1/18/2007	5.35	18.7	14.85	6.97	1452	Slightly cloudy to clear, no sediment	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-525	1/18/2007	5.41	4.52	14.93	7.04	1284	Clear, odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-526	1/19/2007	5.45	12.1	14.78	7.19	1238	Clear, frothy, PID - 45ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-527	1/19/2007	-	9.13	14.64	7.15	1227	Clear, odor	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-528	1/19/2007	5.47	10.9	14.63	7.00	1288	Clear, frothy, odor, PID - 30ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-529	1/19/2007	5.42	5.38	14.61	7.15	1537	None	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-530	1/22/2007	5.51	-	14.35	7.18	1540	Clear, odor, PID - 306ppm	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-531	1/22/2007	5.52	12.6	14.32	7.24	1430	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-532	1/23/2007	5.54	4	14.77	7.04	1244	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

TABLE 3
Monitoring and Injection Well Development Table
OMC Plant 2

			Ending Parameters					
Well ID	Date Developed	Initial DTW (ft btoc)	Turbidity (NTU)	Temp (C)	pH	Conductance (uS/cm)	Remarks	Development Method
IW-533	1/23/2007	5.55	2	14.82	6.96	1315	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-534	1/23/2007	5.57	2	14.58	6.96	1304	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-535	1/22/2007	5.72	-	14.72	7.06	1378	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-536	1/22/2007	5.54	-	14.59	7.10	1428	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
IW-537	1/22/2007	5.55	4.56	14.83	7.30	1457	Clear	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

a. ft btoc = feet below top of casing.
b. NTU = National Turbidity Units.
c. Temp = Temperature.
d. NA = Not Available.
e. SCH = Schedule.
f. PVC = PolyVinyl Chloride.
g. PID = Photo Ionization Detector.
h. ppm = parts per million.
i. DNAPL = Dense Non-Aqueous Phase Liquid

TABLE 4
Groundwater Field Parameters Summary
OMC Plant 2 Site

		Initial	Ending Parameters							
Well ID	**Well Depth (ft)**	**DTW (ft)**	**DTW (ft)**	**pH**	**Temp (C)**	**Conductance (µS/cm)**	**DO (mg/L)**	**Turbidity (NTU)**	**ORP (mV)**	**Flow Rate (ml/min)**
Existing Monitoring Wells										
W-1	NS	4.36	4.40	7.38	6.76	1413	0.22	12.9	-103.4	180
W-2	24.20	5.11	5.14	7.32	8.50	1758	0.22	6.9	25.6	180
W-3	24.15	3.91	3.98	7.20	7.98	1062	0.21	21.6	-84.9	150
W-4	NS - frozen									
W-5	35.21	6.95	7.03	7.92	7.72	501	1.74	9.7	-18.8	180
W-6	32.11	NS	6.71	7.11	10.54	2430	2.27	5.3	-78.5	180
W-7	30.84	4.85	4.94	7.66	7.88	558	0.18	-110.7	-116.2	180
W-8	34.53	5.08	5.15	7.52	5.74	835	0.30	2.3	-132.6	180
W-9	27.30	NS	5.31	7.35	8.68	1155	1.48	53.1	-90.2	180
W-10	24.87	NS	4.50	7.14	8.69	1389	1.57	64.7	-58.8	200
W-11	11.70	6.05	6.10	7.86	9.22	1046	0.88	-11.7	56.6	150
W-12	29.10	4.97	5.02	7.29	6.69	837	4.70	-116.3	-69.5	200
W-13	12.49	NS	5.58	7.04	6.43	404	0.13	4.3	-165.2	220
MW-5	11.64	6.48	6.50	7.04	7.52	1041	0.17	-2.5	-118.8	150
MW-100	NS - can't locate									
MW-101	NS - can't locate									
MW-102	NS - damaged									
MW-3S	6.04	5.74	5.77	6.90	5.86	523	9.41	24.2	142.9	160
MW-3D	NS	5.71	5.71	8.15	9.13	4902	0.59	-294.2	-286.2	190
MW-11S	9.27	6.33	6.31	7.28	4.84	540	1.31	17.6	-78.0	180
MW-11D	28.51	6.18	6.23	7.20	8.71	1220	0.25	27.9	-95.3	190
MW-14S	3.40	1.87	1.90	7.43	5.35	460	0.68	-0.9	-101.5	200
MW-14D	29.78	2.00	2.10	8.26	8.46	2873	0.26	-1.2	-163.7	220
MW-15S	11.80	2.81	2.80	7.08	6.25	361	0.97	1.1	170.5	200
MW-15D	28.60	2.88	2.93	6.91	8.44	1087	0.21	12.3	-98.8	180
Chemical Storage Area										
MW-509S	NS	1.04	1.04	7.39	2.50	403	3.80	3.4	23.0	160
MW-509D	NS	1.05	1.08	7.36	8.63	1495	2.06	36.1	-106.5	200
MW-517S	9.72	3.67	3.66	7.25	4.62	571	1.87	-19.2	-100.7	150
MW-517D										
Outside of Chip Dock Area										
MW-502S	8.70	5.14	5.16	7.11	3.96	715	0.17	-0.5	-103.7	155
MW-502D	26.11	5.80	5.10	6.89	9.63	1563	1.85	35.10	-77.6	150
Outside of Chip Room										
MW-503S	NS - LNAPL									
MW-503D	23.63	2.27	2.36	6.65	8.62	2437	6.94	-11.1	-91.2	150
Parking Lot between Old Die Cast Area and New Die Cast Area										
MW-507S	9.6	4.6	4.61	7.3	4.93	357	0.43	-0.1	-118.2	180
MW-507D	26.01	4.6	4.6	7.46	10.82	875	0.81	-3.3	-111.0	160
MW-523S	8.55	6.45	6.4	7.24	4.86	372	6.17	2.2	160.0	180
MW-523D	28.45	6.35	6.35	7.16	11.19	1222	2.00	90.4	-96.1	180
MW-524S	9.51	6.20	6.2	7.57	4.86	476	6.60	-4.3	86.5	180
MW-524D	NS - not installed									
MW-525S	9.60	6.55	6.5	7.46	5.39	345	8.46	2.1	157.1	180
MW-525D	28.80	6.40	6.4	7.39	11.11	1188	0.95	15.8	-69.3	180
MW-526S	11.54	6.20	6.03	7.42	6.09	553	1.76	-4.2	-125.0	140
MW-526D	29.11	6.20	6.08	7.39	9.54	1156	1.25	7.0	-95.0	150
Near Corporate Offices										
MW-513S	7.6	3.76	3.77	7.45	5.89	561	0.19	8.2	-78.6	160
MW-513D	23.31	3.8	3.85	7.30	10.76	1037	0.98	22.1	-89.2	170
MW-514S	6.93	3.66	3.66	6.90	7.00	735	0.21	1.4	218.6	200
MW-514D	24.92	3.68	3.68	7.26	11.82	981	0.47	8.3	-117.1	195
MW-527S	7.75	3.20	3.2	7.05	4.65	779	1.49	1.3	-60	160
MW-527D	26.86	3.78	3.83	6.79	9.65	1771	0.32	9.1	.114.6	180
MW-528S	10.13	5.26	5.24	7.10	7.01	729	0.65	2.0	74.3	200
MW-528D	25.81	5.25	5.25	7.05	11.59	2282	2.00	7.1	-116.5	180
MW-529S	9.80	4.83	4.83	6.93	6.82	857	1.00	1.0	-111.9	180
MW-529D	25.44	4.91	4.96	7.19	10.07	1509	0.43	2.6	-95.9	170
Larson Marine Property - Near Slip 4										
MW-515S (north of Seahorse Drive)	7.90	2.20	2.30	7.09	4.11	400	0.23	-4.8	-72.7	180
MW-515D (north of Seahorse Drive)	26.23	2.15	2.20	7.06	9.30	2357	1.10	-23.1	-107.3	180
MW-516S	8.50	4.20	4.22	6.70	4.35	824	0.16	-5.0	-30.5	180
MW-516D	25.41	4.30	4.32	7.22	9.93	6674	1.38	-4.2	-123.4	200

TABLE 4
Groundwater Field Parameters Summary
OMC Plant 2 Site

Well ID	Well Depth (ft)	Initial DTW (ft)	Ending Parameters DTW (ft)	pH	Temp (C)	Conductance (µS/cm)	DO (mg/L)	Turbidity (NTU)	ORP (mV)	Flow Rate (ml/min)
Within the Plant 2 Building										
MW-504S	9.40	6.43	6.45	6.81	7.22	NS	0.13	1.4	-11.7	180
MW-504D	28.20	6.42	6.45	7.16	11.14	1481	0.24	-15.4	-114.3	160
MW-505S	8.75	5.83	5.88	6.80	8.98	864	0.47	9.5	-101.2	160
MW-505D	NS	5.65	5.65	6.99	12.62	1256	0.36	32.4	-58.2	160
MW-506S	9.25	6.00	5.95	7.05	7.91	886	4.03	-2.4	-83.6	180
MW-506D	27.56	5.92	5.98	6.90	10.96	1230	2.52	-13.8	-23.0	170
MW-510S	9.27	6.01	6.11	6.99	8.80	578	2.21	-20.8	22.6	145
MW-510D	27.28	6.05	6.10	7.26	12.35	1288	0.28	7.5	-71.9	145
MW-511S	9.27	6.60	6.61	6.95	7.74	568	0.43	1.0	126.9	170
MW-511D	28.18	6.65	6.68	7.40	12.04	663	0.35	-0.3	-142.5	160
MW-518S	10.58	5.92	5.94	7.00	8.00	704	0.37	5.5	-97.2	205
MW-518D	26.81	5.94	5.99	7.09	10.36	1467	2.47	15.4	19.8	200
MW-519S	14.85	5.32	5.35	7.31	9.56	1048	0.34	9.9	-120.7	160
MW-519D	26.30	5.33	5.4	6.65	11.34	1014	1.20	3.9	-142.5	180
MW-520S	15.20	5.51	5.51	7.34	11.60	791	0.33	6.0	-90.9	200
MW-520D	26.14	5.72	5.72	7	12.97	1239	0.19	23.3	-57	180
MW-521S	14.98	5.49	5.5	7.38	11.12	1077	0.50	32.1	-77.9	180
MW-521D	25.35	5.68	5.71	7.22	12.87	1281	0.20	24.4	-89.9	180
MW-522S	15.35	5.74	5.77	7.46	11.22	1121	0.70	14.80	-119.1	200
MW-522D	26.03	5.76	5.81	7.02	11.84	1405	0.26	13.70	-94.2	200
Additonal Monitoring Wells Locations										
MW-508S (along eastern access road)	6.23	3.45	3.50	7.32	4.86	283	0.29	0.9	-97.4	195
MW-508D (along eastern access road)	29.49	3.43	3.52	7.41	11.17	392	2.22	0.0	-121.6	170
MW-512S (south of Triax Building)	7.31	3.25	3.24	7.24	6.25	437	0.33	31.9	40.3	200
MW-512D (south of Triax Building)	NS	3.31	3.10	7.25	12.84	984	0.22	7.3	-136.5	200
Replacement Monitoring Well Locations										
MW-500S	9.06	4.30	4.30	7.84	2.49	566	1.19	6.1	116.9	180
MW-500D	27.10	4.28	4.35	7.41	10.64	1360	0.66	27.6	-98.5	180
MW-501S	NS- frozen									

a. "DTW" represents "Depth To Water".
b. All depth to water measurements are below top of casing.
c. "Temp" represents "Temperature".
d. "DO" represents "Dissolved Oxygen".
e. "NTU" represents "National Turbidity Units".
f. "ORP" represents "Oxidation Reduction Potential".
g. "psi" represents "Pounds Per Square Inch".
h. "NS" represents "Not Sampled"

Figures

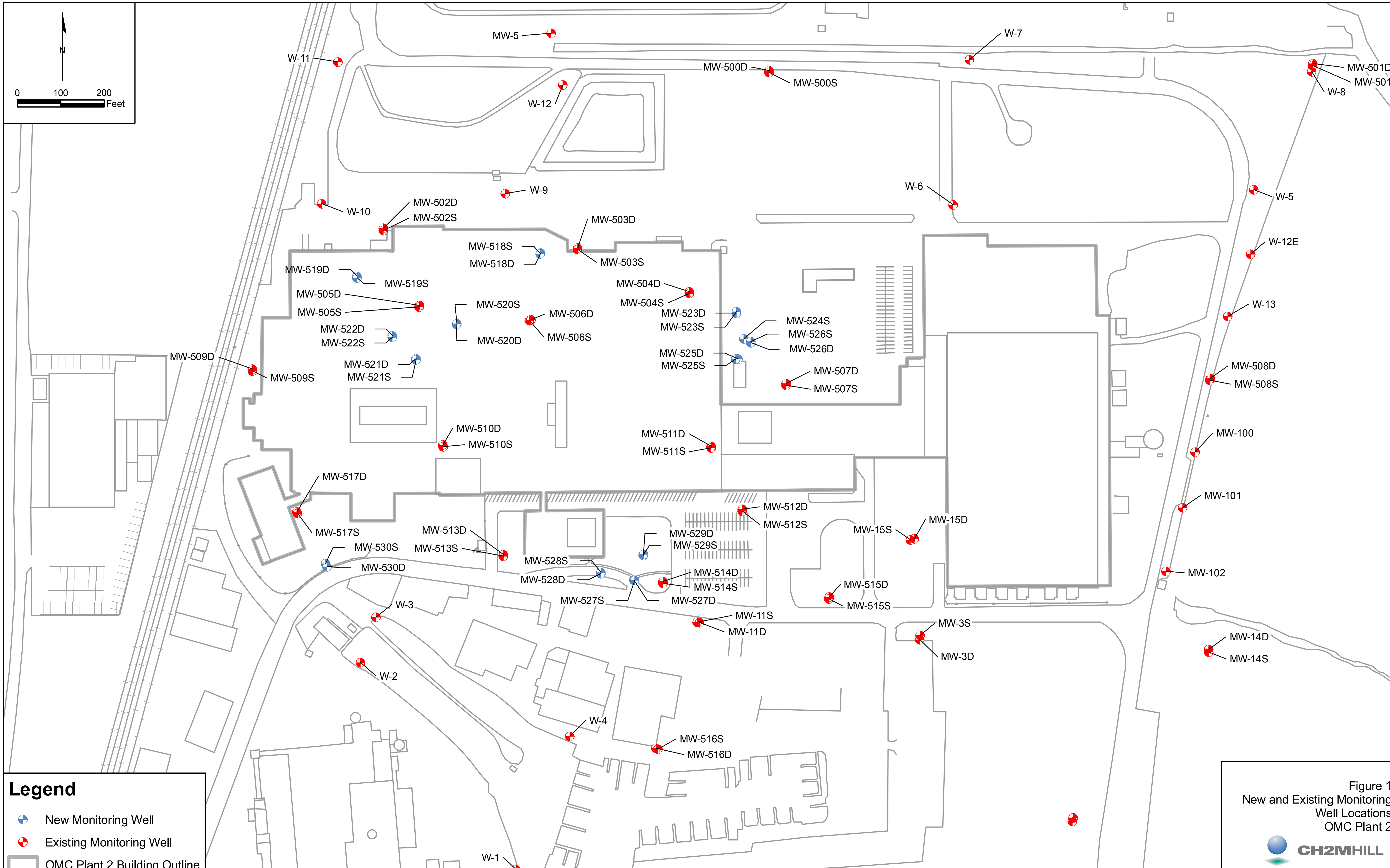


Figure 1
New and Existing Monitoring
Well Locations
OMC Plant 2

File Path: E:\EPA\186305-OMC\GIS_DATA\MXDS\041107\Figure1_New_Existing_MW_PZ.mxd, Date: 04 11, 2007 9:51:25 AM, User: JHANSEN1

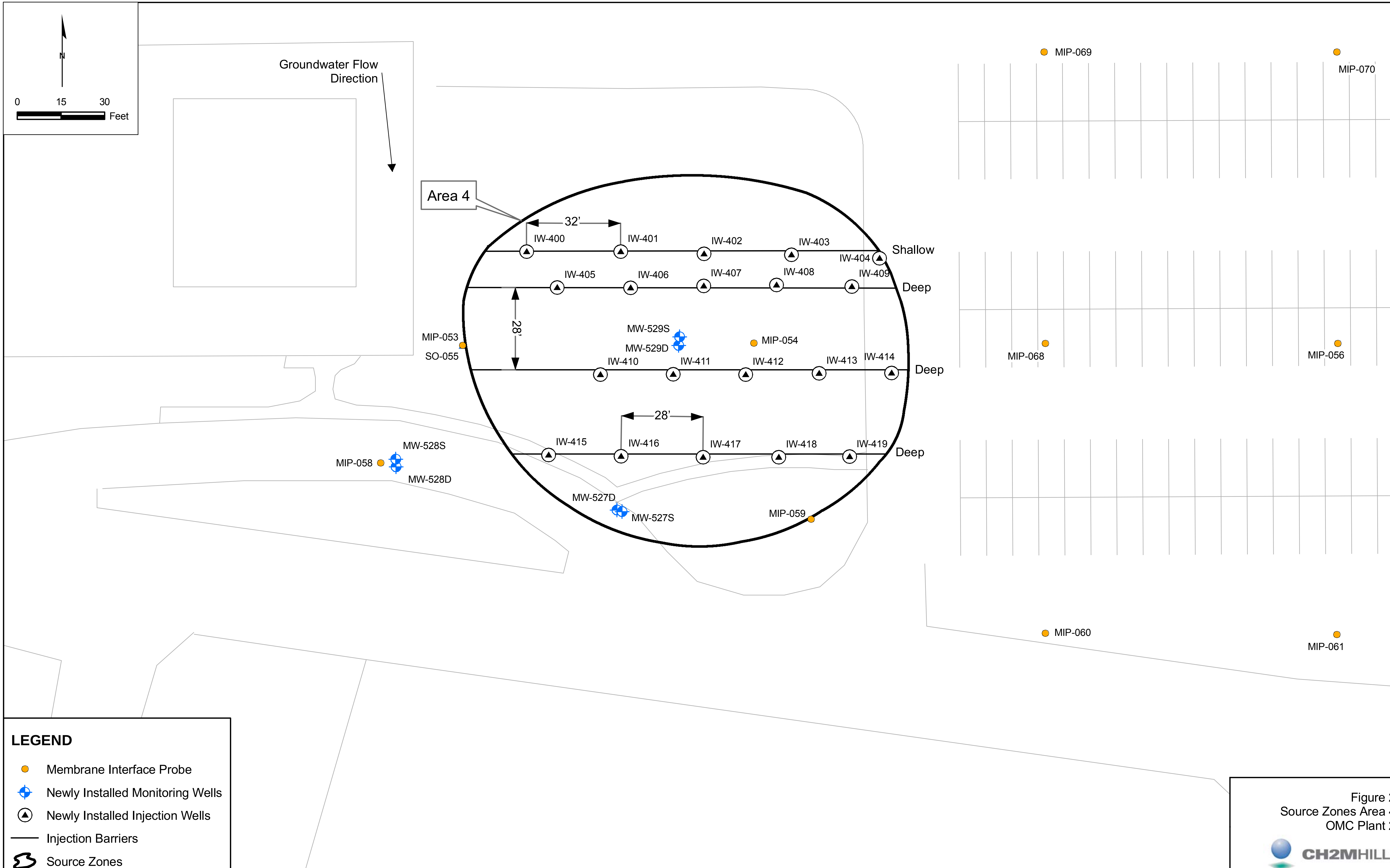
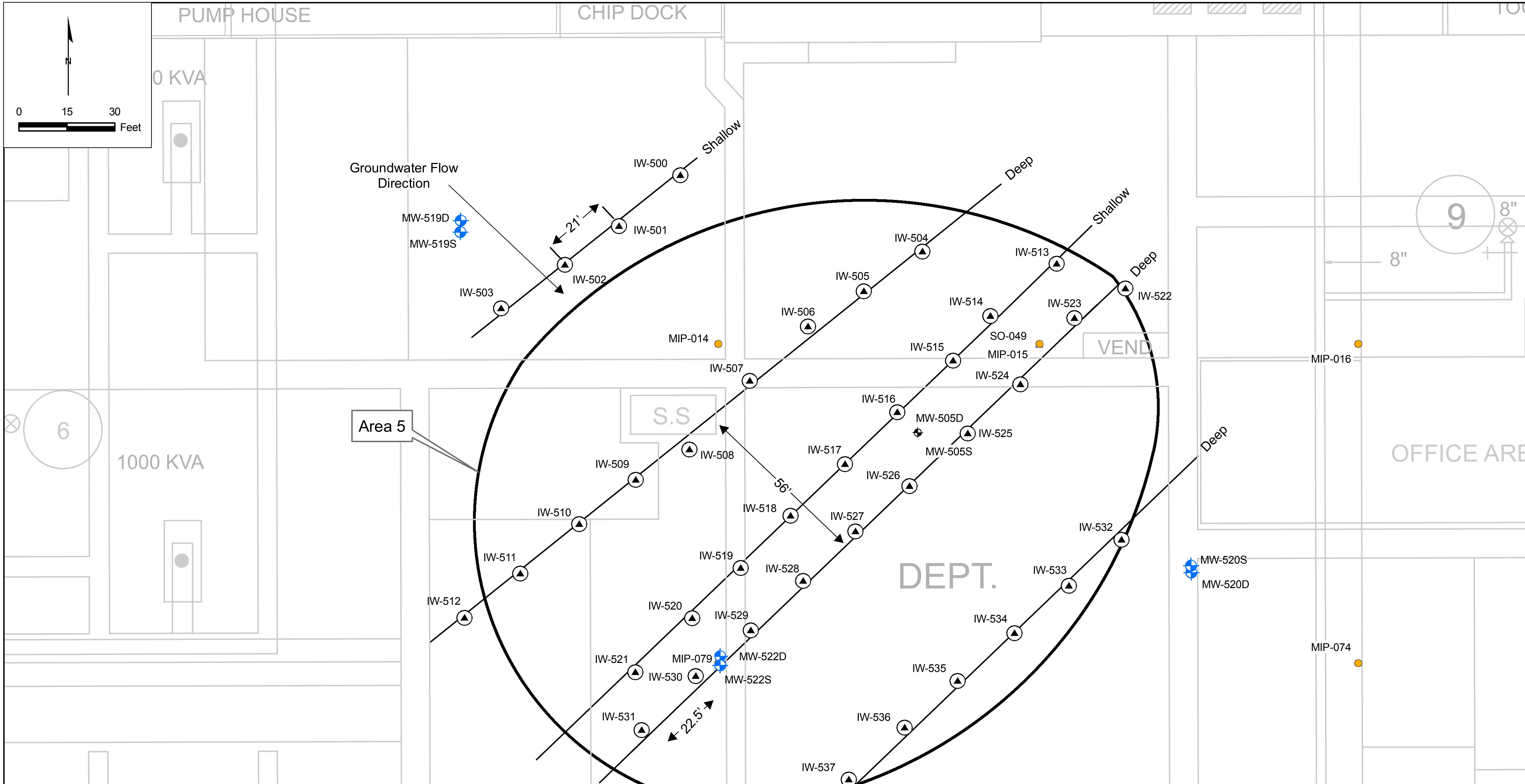


Figure 2
Source Zones Area 4
OMC Plant 2

CH2MHILL

File Path: E:\EPA\186305-OMC\GIS_DATA\MXDS\Hydrogeologic Investigation Report March 2007\Figure02_Source_Zones_Area4.mxd, Date: 05 31, 2007 12:39:51 PM, User: JHANSEN1



LEGEND

- Membrane Interface Probe
- Newly Installed Monitoring Wells
- Newly Installed Injection Wells
- Injection Barriers
- Source Zones

Figure 3
Source Zones Area 5
OMC Plant 2

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File Path: E:\EPA\186305-OMC\GIS_DATA\MXDS\Hydrogeologic Investigation Report March 2007\Figure03_Source_Zones_Area5_rooms.mxd, Date: 05 31, 2007 11:36:55 AM, User: JHANSEN1

Attachment 1

Monitoring Well Installation Soil Boring Logs

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	MW-518D	SHEET 1 OF 2

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 0930 FINISH: 1100 LOGGER: EM/VBR

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 6": Concrete core	0': NA
1	0'-4'	1	2/4		6" - 2.5': Sand, fine-medium grain, trace gravel throughout, brown from 6" - 1.5' and light brown from 1.5' - 2.5', moist, dry	1': 0.7
2						2': 0.6
3						3.25': 0.6
4					4 - 5.5': Sand, fine-medium grain, ~ 3: lense very fine sand at base, trace gravel throughout, brown, moist	4': 0.7
5	4'-8'	2	2/4		5.5 - 6.5': Sand, fine-medium grain, dark brown-dark dark gray stain, moist; well sorted; strong odor; has sheen from 5.5 - ~ 6', gray from 6 - 6.5'; no sheen; little odor	5': 1
6						6': 0.7
7						7': NR
8					8 - 8.5': Sand, medium-coarse, gray, brown, moist; moderately-poorly sorted	8': 0.8
9	8'-12'	3	2.3/4		8.5 - 9': Sand, medium fine-medium, grayish-brown, wet; well sorted	9': 0.8
10					9 - 9.5': Gravel, fine, sand, coarse, wet; moderate-well sorted	10': 1
11					9.5 - 10': Sand, fine-medium, grayish-brown, trace coarse sand, wet; well sorted	11': NR
12					10 - 10.3': Sand, coarse, trace gravel, moderate-poorly sorted, fine sand (10.2 - 10.5'), gray-light brown, wet	12': 1
13	12'-16'	4	2.1/4		12 - 14.1': Sand, fine-moderate grained, trace gravel (0.5 - 1"), well sorted, moist, grayish-brown	13': 6.7
14						14': 5.4
15						15': NR
16					16 - 18': Sand, fine-medium, well sorted, 2" lense with white gravel, moist, wet, grayish-brown	16': 22.6
17	16'-20'	5	2.5/4			17': 49.2
18					18 - 18.5': Sand, fine, well sorted, no white grains, wet, grayish brown	18': 112
19						19': NR
20					20 - 22.3': Sand, fine, well sorted, trace travel (~ 21.5 - 22.3'), grayish-brown, slightly dark gray (21.5 - 22.3'); slight odor	20': 82.9
21	20'-24'	6	23/4			21': 33.3
22						22': 19.3
23						23': NR
24					24 - 26.7': Sand, fine, well sorted, trace travel (25.5' - 25.7'), grayish-brown, wet throughout; slight odor at top	24': 3.3
25	24'-28'	7	2.8/4			25': 7.4
26						26': 16.7
27						27': NR

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-518D	SHEET 2 OF 2

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 0930 FINISH: 1100 LOGGER: EM/VBR

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
28					28 - 28.4': Gravel, fine-coarse, poorly sorted, angular, trace fine-coarse sand, grayish-brown, wet	
29	28'-32'	8	1.6/4		28.4 - 29.6': Silty clay, stiff, dense, low plasticity, dry, slightly moist, grayish-brown	
30					29.6' - 32': NR	
31						
32					32' - End of boring	32':
33						31':
34					**Total Depth -** 32'	32':

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-519D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 — LOCATION: Waukegan, IL
ELEVATION: — DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: — START: 0915 — FINISH: 1115 — LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 0.5': Concrete	
1	0'-4'	1	2.75/4		0.5 - 1.25': Fill (S&G), brown, dry-moist; poorly sorted.	1': 0.6
2						2': 0.2
					1.25 - 2.75': Sand with some gravel	2.5': 0.1
3						
4						4': 0.1
					4 - 5": Same as above, more coarse sand, brown to dark brown	
5	4'-8'	2	2.3/4			5': 0.2
					5 - 5.5': Fine sand, brown, wet; well sorted	
6					5.5': Fine-medium sand, brown-gray, wet; occ. gravel (1/3" - 1/3")	6': 0.1
7						
8					8 - 9.2': Fine sand, gray, wet; well sorted; trace gravel (1 1/2"); black staining and trace organic debris from 8 - 8.5'; odor	8': 2.2
9	8'-12'	3	2.25/4			9': 0.3
					8.2 - 9.5': Sand (fine-coarse) with gravel (1/2"), gray, wet; slight odor	
10						10': 0.6
					9.5 - 10.25': Fine sand, gray, wet; well sorted; chemical odor; trace gravel (1/2")	
11						
12						12;" 0.3
					12 - 14.75': Fine sand, gray, wet; well sorted; very slight odor; trace gravel at 12'; lens of fine; coarse sand at 13.5'	
13	12'-16'	4	2.75/4			13': 0.2
14						14': 0.2
15						15': 0.2
16						16': 0.1
					16 - 18.25': Fine sand, gray; well sorted, trace gravel at 17'; becoming very fine with depth; no odor	
17	16'-20'	5	2.25/4			17': 0.1
18						18' 0.1
19						
20						20': 0.1
					20 - 20.7': Fine sand/ gray to grown-gray, wet; well sorted; slight odor	
21	20'-24'	6	2.7/4			21': 0.1
22						22': 0.1
23						
24					24 - 24.75': Fine sand	24': 15.7
					24.75 - 24.9': Gravel	
25	24'-28'	7	1.7/4		24.9': Top of till (clay)	
					25.8' - End of boring	
26						
27						
28						
29						
30					**Total Depth - 25.8'**	

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	MW-520D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 — LOCATION: Waukegan, IL

ELEVATION: — DRILLING CONTRACTOR: IPS

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT

WATER LEVELS: — START: 1245 — FINISH: 1515 — LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 5': Concrete	
1	0'-4'	1	2/4		0.5 - 1.0': Fill (clayey sand with gravel), brown, moist-dry poorly sorted	1': 0.1
2					1.0 - 2.5': Medium sand, brown, loose, moist-dry; trace gravel (1/2" - 1")	2': 0.3
3						
4					4 - 4.75': Same as above 4 - 75 - 5.3': Fine-medium sand, gray-dark gray, moist tc wet; clay lense	4': 0.2
5	4'-8'	2	2.5/4		5.3 - 5.75': Fine sand, black-stained, moist to wet; trace (glass, coal, metal, nails, pottery)	5': 0.2
6					5.75 - 6.1': Fine-medium sand, gray to dark gray, moist-wet; trace gravel	6': 0.0 6.5': 0.2
7					6.1 - 6.25': Woody debris in a sandy clay matrix, black 6.25 - 6.4': Silty clay, gray, soft; wet	
8					6.4 - 6.5': Woody debris in a sandy matirx, black, wet	8': 0.2
9	8'-12'	3	2.7/4		8 - 8.25': Fine-medium sand, dark gray, wet; well sorted; roots; (gravel lens at 8.5') 8.5 - 9.7': Same as above; no roots or gravel	9': 0.2
10					9.7 - 10.7': Medium sand, dark gray, wet; trace gravel (1/2"); speckled (salt and pepper) appearance	10': 0.3
11						
12						12': 0.5
13	12'-16'	4	2.7/4		12 - 14.7': Sand (fine-medium grading to fine), gray to brown-gray, wet; well sorted	13': 0.5
14						14': 3.1 14.5: 7.1
15						
16					16 - 17.75': fine; silty sand; gray; wet; well sorted; no dodor; but PID readings elevated	16': 293
17	16'-20'	5	1.75/4			17': 361 17.5': 401
18						
19						
20					No recovery 20 - 20' (cutting shoe broken)	
21	20'-24'	6	0/4			
22						
23						
24					24 - 24.95': Fine, silty sand, gray-brown, wet; slight odor well-sorted	24': 841
25	24'-28'	7	2.2/4		24.75 - 25': Sand and gravel, gray, wet; poorly sorted; subangular to subrounded grains	25': 230
26					25' - Top of till: Clay, gray, dry; trace gravel 26.2' - End of boring	26': 18.0
27						
28						
29						
30					**Total Depth - 26.2'**	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-521D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 1540 (1/23) FINISH: 0840 (1/24) LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 5': Concrete (from coring)	0': 0.8
1	0'-4'	1	2/4		0.5 - 2.5': Sand (fine with occasional coarse), light brown, dry to moist; trace gravel (1/2" - 1")	1': 0.3
2						2': 0.2
3						
4					4 - 4.5': Sand (fine-medium with some coarse), brown-gray, dry-moist; trace gravel (1/2" - 3/4')	4': 0.4
5	4'-8'	2	2.6/4		4.5 - 9': Sand and gravel, red-brown, moist-dry; poorly sorted	5': 0.3
6					4.9 - 5.3': Fine-medium sand, red-brown, moist; well sorted; trace coarse	6': 0.2
7					5.3 - 6': Alternating layers of sand and silty sand (sand is fine, gray, moist; silty sand is black, moist, with trace organics); a few fine lenses of clay	
8					6 - 6.6': Medium sand, gray, wet; some coarse sand	8': 0.2
9	8'-12'	3	2.2/4		8 - 9.3': Fine-medium sand, gray, wet; well sorted	9': 0.2
10					9.3 - 10': Medium to coarse sand with some fine gravel, gray, wet; medium to poorly sorted; grain size grades coarser with depth	10': 0.2
11					10 - 10.2': Fine sand; gray, wet; well sorted	
12					12 - 14.7': fine sand, gray, wet; trace gravel (1/2")' from 13.5 - 13.8 is a layer of medium sand with some coarse; gray; wet; grace gravel	12': 0.6
13	12'-16'	4	2.7/4			13': 0.5
14						14': 0.5
15						
16					16 - 17.7': Fine-medium sand, brown-gray, wet	16': 2
17	16'-20'	5	2.7/4		16.7 - 17.5': Medium sand with some fine sand, brown-gray, wet; trace coarse and gravel	17': 41.7
18					17.5 - 18.7': Fine sand, brown-gray, wet; 1" layer of medium sand at 18'; well sorted	18': 29.4
19						
20						20': 11.1
21	20'-24'	6	1.75/4		20 - 21.95': Fine to very fine sand, gray, wet; dark gray lamination present from 21 - 21.25'	21': 18.6
22						22': 10.9
23						
24					24 - 24.5': Fine-medium sand, gray, wet	24': 83.3
25	24'-28'	7	2/4		24.5 - 24.75': Sandy gravel, gray, wet; poorly sorted 24.75': Top of till (clay, gray, hard)	25': 8.9
26					26' - End of boring	
27						
28						
29						
30					**Total Depth - 26'**	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-522D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 0900 FINISH: 1040 LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS
	INTERVAL (FT)	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
1	0'-4'	1	2.25/4		0 - 0.5': Concrete 0.5 - 0.75': Clayey sand, red-brown, moist, trace gravel, medium sorted	1': 1.1
2					0.75 - 2.25': Fine-medium sand, brown, dry becoming moist, occasional gravel (1/2 - 1") at 2' bgs; observed 1 3/4" piece of asphalt, black conglomerate	2': 0.8
3						3': 0.6
4					4 - 4.6': Same as above 4.6 - 5': Crushed limestone?, white (sand and gravel), poorly sorted, angular grains	4': 1.8
5	4'-8'	2	3/4		5 - 5.25': Gravelly, silty, sand, red-brown, moist, poorly sorted	5': 2.5
6					5.25 - 5.6': Fine sand, dark brown-gray, moist, occasional gravel (1/2"), trace woody debris	6': 0
7					5.6 - 6': Fine-medium sand, gray, moist, trace gravel 6 - 6.5': Fine sand, dark gray, moist, with fine lenses of gray silt	
8					6.5 - 7': Fine-medium sand, gray, moist-wet, well sorted	8': 16.8
9	8'-12'	3	3/4		8 - 8.4': Same as above; wet 8.4 - 9.25': Medium sand, gray-dark gray, wet, well sorted	9': 35/66.8
10					9.25 - 11': Sand, fine-medium to fine, gray, wet, trace gravel	10': 0.4
11						11': 0.3
12					12 - 12.7': Fine-medium sand, wet, gray 12.7 - 14': Fine sand, gray, moist (fine layer of medium sand at 12.1')	12': 0
13	12'-16'	4	2/4			13': 0
14						14': 0.6
15						
16					16 - 17.4': Sand, fine-medium, gray, wet	16': 4.8
17	16'-20'	5	2.4/4		17.4 - 18.4': Sand, fine-very fine, gray, wet	17': 33.4
18						18': 68.7
19						
20					20 - 22.1': Sand, fine-very fine, gray, wet, trace coarse sands, fine lense of coarse sand at 21'	20': 54.7
21	20'-24'	6	2.1/4			21': 80.1
22						22': 52
23						
24					24 - 24.5': Gravelly sand, gray, poorly sorted wet, odor 24.25 - 24.75': Fine sand, gray, wet, strong odor 24.75 - 25': Gravelly sand, gray, poorly sorted, odor	
25	24'-28'	7	2.25/4		25': Top of till, gray, very firm	
26						
27					26.25' - End of boring	
28						
29						
30					**Total Depth - 26.25'**	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-523D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 1405 FINISH: 1525 LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 0.75': Silty, gravelly, sand, red-grown, dry, loose,	0': 0.2
1	0'-4'	1	2.25/4		poorly sorted	1': 0.8
					0.75 - 2.25': Medium sand, brown, moist; black staining	
2					2' - 2.3'	2': 0.3
3						
4						4': 1.8
					4 - 4.15': Sand (firm), gray-brow, moist, well sorted	
5	4'-8'	2	3.5/4		4.15 - 4.3': Black, same as above	5': 0.3
					4.3 - 6': Fine-medium sand, brown, wet; trace gravel	
6					6 - 6.6': Sandy gravel; brown, wet; gravel 1/8" - 1"	6': 0.3
					6.6 - 7.5': Fine sand, brown, wet, trace gravel	
7						7': 2.3
8					8 - 10.75': Fine sand, brown, wet;	8': 135
					1/2 to 1" grains { 2" gravelly sand starting at 8.75'	
9	8'-12'	3	2.75/4		1 1/2" gravelly sand starting at 9.5'	9': 103
10						10': 262
11						
12						12': 496
					12 - 13.2': fine sand, brown, wet, well sorted	
13	12'-16'	4	2.4/4		13.2 - 13.5': Medium sand layer	13': 486
					13.5 - 14.4': Fine sand, gray-brown, wet; a few minor	
14					medium-grained lenses	14': 458
15						
16					16 - 16.25': fine sand, brown-gray, wet; trace coarse	16': 354
					sand	
17	16'-20'	5	2.5/4		16.25 - 16.7': Coarse sand, gray, wet; trace travel	17': 903
					16.7 - 17.7': Fine sand, brown-gray, wet; well sorted; odor	
18						18': 941
19						
20					20 - 22': Silty, fine sand, gray, wet; well sorted, odor,	20': 2216
21	20'-24'	6	2/4			21': 1812
22						22': 1761
23						
24					24 - 25.2': Fine sand, gray, wet, odor; well sorted	24': 4707
					25.2 - 25.4': Silty clay, gray, wet, very soft, no odor	
25	24'-28'	7	2.5/4		25.4 - 25.8': Silty gravel, gray, wet; poorly sorted	25': 851
					25.8': Top of till (silty clay with gravel; poorly sorted	
26						26':
27					26.5' - End of boring	27':
28						28':
29	28'-32'	8	/2			29':
30					**Total Depth - 26.5'**	30':

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-524D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 — LOCATION: Waukegan, IL

ELEVATION: — DRILLING CONTRACTOR: IPS

DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT

WATER LEVELS: — START: 1100 — FINISH: 1340 — LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
1	0'-4'	1	2/4		0 - 0.5': Gravelly sand, brown and black, dry, loose, gravel comprised of asphalt	0': 0 1': 2.6
2					0.5 - 0.9': Fine-medium sand, black, moist, some gravel, moist, gravel is slag (vesicular nodules)	2': 7.3
3					0.9' - 1.8': Medium sand, brown, moist-wet, trace gravel	
4					4 - 4.5': Fine-medium sand with occasional gravel and coarse, brown, wet	4': 11.8
5	4'-8'	2	2.5/4		4.5 - 6.5': Sand, fine-medium, brown, wet, trace gravel (3/4")	5': 16.2
6						6': 51.1
7						
8					8 - 8.25': Same as above	8': 153
9	8'-12'	3	2.6/4		8.25 - 8.75': Gravelly, sand, wet, brown, medium to poorly sorted, odor	9': 57.6
10					8.75 - 9.6': Fine-medium sand, brown, wet, well sorted, very slight odor	10': 10.2
11					Note: I think this is #2 (or #3)	
12					4 - 4.25': Medium sand, dark gray, wet, trace coarse 4.25 - 4.5': Sandy gravel, brown, wet (1/4 - 1"), poorly sorted	4': 4.3 5': 7
13	12'-16'	4	3.25/4		4.5 - 5.25': Sand, medium to medium-coarse, brown, wet, well sorted	6': 4.9
14					5.25 - 9.25': Sand, fine-medium to fine, brown, wet, well sorted	7': 7.2
15						
16					16 - 16.5": Fine sand, brown-gray, wet 16.5 - 17': fine to medium	16': 2.4
17	16'-20'	5	2.25/4		17': Grades to medium sand 17.5': Grades to medium-coarse	17': 4.8
18					17.5 - 17.7': Coarse sand, gray, wet, well sorted 17.7 - 17.85': Organic layer (wood fibers visible); peat moss?	18': 0.2
19					17.85 - 18.25': Fine sand, gray, wet, trace gravel (1")	
20					20 - 22.6': fine to very fine sand, gray, wet, well sorted	20': 0
21	20'-24'	6	2.6/4			21': 0
22						22': 0
23						
24					24 - 25.5': Same as above; strong odor	24': 285
25	24'-28'	7	2.5/4		25.5 - 26': silty, sandy, gravel; gravel pieces (1/4 - 2"), NAPL observed (amber colored), very strong odor	25': 419 25.5': 861
26					26': - Top of till (clay, gray, very fine to stiff, trace gravel, strong odor)	26': 9999/max
27					26.5' - End of boring	27': Note: Liner turned opaque and pale yellow on bottom portion
28						28':
29						29':
30					**Total Depth - 26.5'**	30':

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-525D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 1540 FINISH: 1650 LOGGER: E. Molander

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 0.25': Sand, poorly sorted, dark gray, dry, loose	0': 0
1	0'-4'	1	2.2/4		0.25 - 0.75': Sandy gravel, red-brown, dry, loose (gravel ~ 1/8 - 2"), poorly sorted	1': 0
2					0.75 - 2.2': Fine-medium sand, grown, wet at 1.5'; dark gray top 2"; trace gravel	2': 0
3						
4					4 - 4.3': Same as above 4.3 - 4.5': Fine to coarse sand, black, wet; poorly sorted	4': 0
5	4'-8'	2	3.75/4		4.5 - 5.8': Fine-medium sand, brown, wet, well sorted 5.8 - 6.3': Medium to coarse sand, brown, wet; trace gravel	5': 0
6					6.3 - 7.75': Fine-medium sand, brown, wet	6': 0
7						7': 8.5
8					8 - 8.5': Gravelly sand, brown, wet, poorly sorted 8.4 - 11.75': Fine sand, brown, well sorted, trace	8': 26.6
9	8'-12'	3	3.75/4		travel {1" medium sand layer at 9')	9': 77.6
10						10': 120
11						11': 101
12					12 - 12.5': fine sand, gray, wet, well sorted 12.5 - 12.75': Fine-medium sand with some gravel, gray,	12': 6
13	12'-16'	4	2.3/4		wet 12.75 - 14.3': fine sand, gray, wet, trace gravel	13': 4.7
14						14': 4.1
15						
16					16 - 17': Fine-medium sand, gray-brown, wet; fine lenses of medium sand at 16.5'	16': 3.8
17	16'-20'	5	2.4/4		17 - 17.25': coarse sand, gray, wet; grace gravel; fine lense of clay at top of coarse sand	17': 4.4
18					17.25 - 18.4': Fine to very fine sand, gray, wet, well-sorted; fine dark gray laminae visible	18': 1.8
19						
20					20 - 22': Same as above (no laminae)	20': 7.9
21	20'-24'	6	2/4			21': 96.7
22						22': 26.58
23						
24					24 - 24.5': fine sand, gray, wet, strong odor 24 - 24.9': Silty, sandy, gravel, gray, wet, poorly sorted,	24': max/9999
25	24'-28'	7	2.1/4		grains are angular, strong odor 24.9': Top of till (clay, gray, very firm, trace gravel)	25': max/9999
26					26.1' - End of boring	26':
27						27':
28						28':
29	28'-32'	8	/2			29':
30					**Total Depth - 26.1'**	30':

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-526D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: START: 0815 FINISH: 1015 LOGGER:

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 0.35': Clayey, sandy silt, red-brown, dry to moist, trace	0': 0
1	0'-4'	1	2.35/4		fine gravel 0.35 - 0.5': Sand, fine-coarse, gray, dry, loom, asphalt	1': 0.5
2					0.5 - 1.9': Sand, fine-medium, brown, moist-wet; well-sorted; trace gravel	2': 0.4
3					1.9 - 2.35': Sand (medium-coarse), brown, wet, occasional gravel (1/2" - 1")	
4					4 - 4.3': Sand (firm), gray, wet, well sorted 4.3-4.9': Gravelly sand (medium), brown, wet,	4': 0
5	4'-8'	2	3.75/4		moderately sorted 4.9 - 7.75': Sand (firm), brown, wet, well sorted, trace	5': 1.7
6					gravel	6': 8.6
7						7': 19.1
8					8 - 11': Sand (firm), brown, wet, trace coarse sand,	8': 3.2
9	8'-12'	3	3/4		well sorted	9': 2.7
10						10': 1.4
11						11': 0.7
12					12 - 12.3': Same as above 12.3 - 12.5': Gravelly sand, brown, wet (1/4" - 3/4")	12': 1.4
13	12'-16'	4	2.25/4		12.5 - 13': Sand (firm), brown, wet, well sorted 13 - 14.75': Fine sand	13': 2
14						14': 2.5
15						
16					16 - 16.3': Same as above 16.3 = 16.5': Sandy gravel layer	16': 2
17	16'-20'	5	2.9/4		16.5 - 18.3': Sand (fine-very fine), gray, wet, well sorted, no odor, trace gravel (1/2")	17': 1.9
18						18': 1.3
19						
20					20': Sand (very fine), gray-dark gray, wet, well sorted, trace travel (1/2")	20': 0.4
21	20'-24'	6	2.8/4			21': 1.7
22						22': 2.9
23						
24					24 - 24.25'': Sand (fine), gray-brown, wet, well sorted, no odor	24': 1.7
25	24'-28'	7	2.4/4		24.25 - 24.9': Sandy gravel, gray, wet, no odor 24.9': top of till (clay, gray, very firm)	25': 1.3
26						
27					26.4' - End of boring	
28						
29						
30					**Total Depth - 26.4'**	

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	WH-527D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe with 4' Macrocore Sampler
WATER LEVELS: START: 1425 FINISH: LOGGER: HJR

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 6": Dark brown gravelly sand engineered fill	0': 0
1	0'-4'	1	29"		6" - 13": Medium brown clay, very stiff 13 - 44": Medium brown medium sand	1': 0
2					44 - 54": S.A.A. with trace stone	2': 0
3						3': 0
4						4': 0
5	4'-8'	2	47"		54 - 66": Medium brown medium sand, wet, medium dense	5': 0
6					66 - 70": Gravel with coarse sand, loose, wet 70 - 153": Medium brown medium and fine sand, loose, wet	6': 0
7						7': 0
8						8': 1
9	8'-12'	3	32"			9': 1.7
10						10': 1
11						11': 0.9
12						12':
13	12'-16'	4	34"		153 - 201": Medium brown, medium sand with trace grave and coarse sand, medium dense decreasing gravel with depth, wet	13': 0.3
14						14': 0.9
15						15': 1.2
16					201 - 300": Dark, bray-brown medium sand, medium dense, wet	16': 0.5
17	16'-20'	5	32"			17': 0.8
18						18': 0.5
19						19': 0.5
20					S.A.A., wet	20': 0.5
21	20'-24'	6	27"			21': 2
22						22': 7
23						23': 0.5
24						24': 0.5
25	24'-28'	7	34"		300 - 336": Dark gray clay, very dense/hard, not plastic	25': 0
26						26': 0
27						27': 0
28					28' - End of boring	28': 0
29					Native till encountered @ 25'	29':
30					**Total Depth - 28'**	30':

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	MW-528D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 LOCATION: Waukegan, IL
ELEVATION: DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe with 4' Macrocore Sampler
WATER LEVELS: START: 0940 FINISH: LOGGER: HJR

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					0 - 15": Orange brown-brown clayey sand fill with gravel and stone	0': 0
1	0'-4'	1	33"		15" - 30": Dark brown medium sand granules and weak structures with trace gravel	1': 0
2					30 - 48": Orange-brown clayey sand, with stones and gravel	2': 0
3					48 - 54": Medium brown medium sand with trace gravel	3': 0
4					54 - 74": Medium brown medium to coarse sand with gravel increasing with depth, loose, granular	4': 0
5	4'-8'	2	36"			5': 0
6					74 - 92": Light brown medium sand with gravel and stone	6': 0
7					92 - 98": S.A.A., wet	7': 0
8						8': 0
9	8'-12'	3	32"		98 - 118": Light brown medium sand, trace gravel, medium dense	9': 0
10					118 - 126": S.A.A. with trace stone, medium dense	10': 0
11					126 - 144": Gravelly stone, with trace coarse-medium sand, loose	11': 0
12					144 - 190": Light brown medium sand with trace coarse sand, wet, medium dense	12': 0
13	12'-16'	4	30"			13': 0.5
14						14': 0.5
15						15': 0.5
16					190 - 202": Medium and coarse sand, medium dense, wet, medium brown	16': 0.5
17	16'-20'	5	32"		202-240 ": Medium brown medium sand with trace fine sand, medium dense, wet	17': 1.2
18						18': 1
19						19': 1
20						20': 0.5
21	20'-24'	6	31"		240 - 332": medium brown fine sand, medium density, we	21': 0.5
22						22': 1
23						23': 5
24						24': 0
25	24'-28'	7	24"			25': 0
26						26': 0
27					332 - 336": Dark gray clay with stone and trace gravel, very dense, slightly plastic	27': 0
28						28': 0
					28' - End of boring	
29						29':
30					**Total Depth - 28'**	30':

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER MW-530D	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: OMC Plant 2 — LOCATION: Waukegan, IL
ELEVATION: — DRILLING CONTRACTOR: IPS
DRILLING METHOD AND EQUIPMENT USED: Geoprobe 6610 DT
WATER LEVELS: — START: 2/28/07 — FINISH: 3/5/07 — LOGGER: I. Mueller

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID reading 0.5 cm above section of core (ppm)
					Sandy clay and gravel mix (GM), dark brown to black,	0':
1	0'-4'	1	26"/48"		wet, subrounded to subangular gravel 1/8" - 1" dia., fine to coarse sand	1':
2					1.5': Fine to coarse sand, light brown, wet, dense (SW)	2':
3						3':
4						4':
					4.5': Trace rounded gravel, 1/8" - 1/2" dia.	
5	4'-8'	2	48"/48"			5':
6					6': Sand size decreases, fine-medium, no gravel	6':
7						7':
8					8': Fine sand, light brown (SP), wet, dense	8':
9	8'-12'	3	32"/48"			9':
10						10':
11						11':
12					12': Fine to coarse sand (SW), wet, light brown, dense	12':
					12.5': Fine sand (SP), wet, light brown, dense	
13	12'-16'	4	30"/48"			13':
14						14':
15						15':
16						16':
					"	
17	16'-20'	5	24"/48"			17':
18						18':
19						19':
20						20':
21	20'-24'	6	26"/48"			21':
22					22': Fine sand (SP) with trace silt and some 1/8" to 1/2" subrounded gravel, light brown, dense, moist	22':
23						23':
					23.5': Clay till (CL), hard, gray, dry	
24						24':
					24' - End of boring	
25	24'-28'	7	/4			25':
26						26':
27						27':
28						28':
29	28'-32'	8	/2			29':
30					**Total Depth - 24.0'**	30':

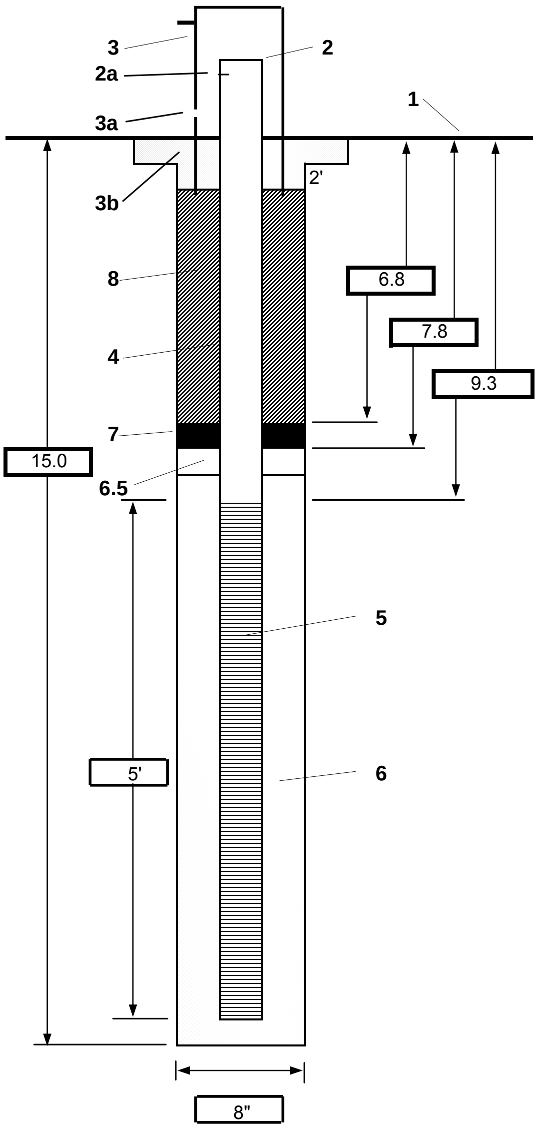
Attachment 2

Monitoring Well Completion Diagrams

	PROJECT NUMBER	WELL NUMBER
CH2MHILL	348136.TT.01	IW-400 SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/26/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 4.60 ft bgs START : 2/26/2007 END: 2/26/2007 LOGGER : I. Mueller



1- Ground elevation at well: 586.73

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 1:05

Estimated purge volume: ~ 130 gal

Comments

	PROJECT NUMBER	WELL NUMBER
CH2MHILL	348136.TT.01	IW-401 SHEET 1 OF 1

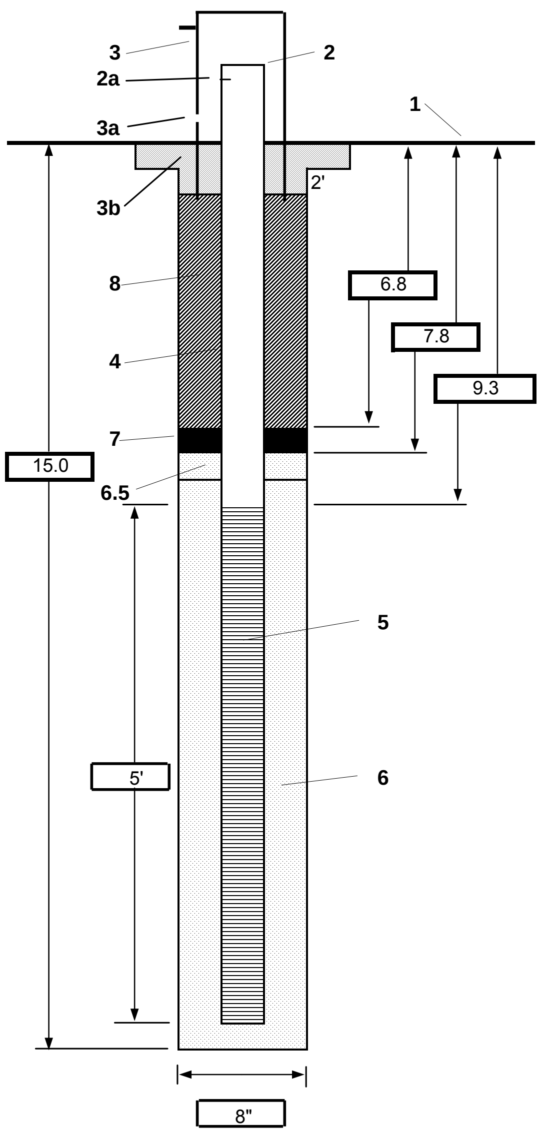
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 3.4 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :



1- Ground elevation at well: 585.94

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel; 0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

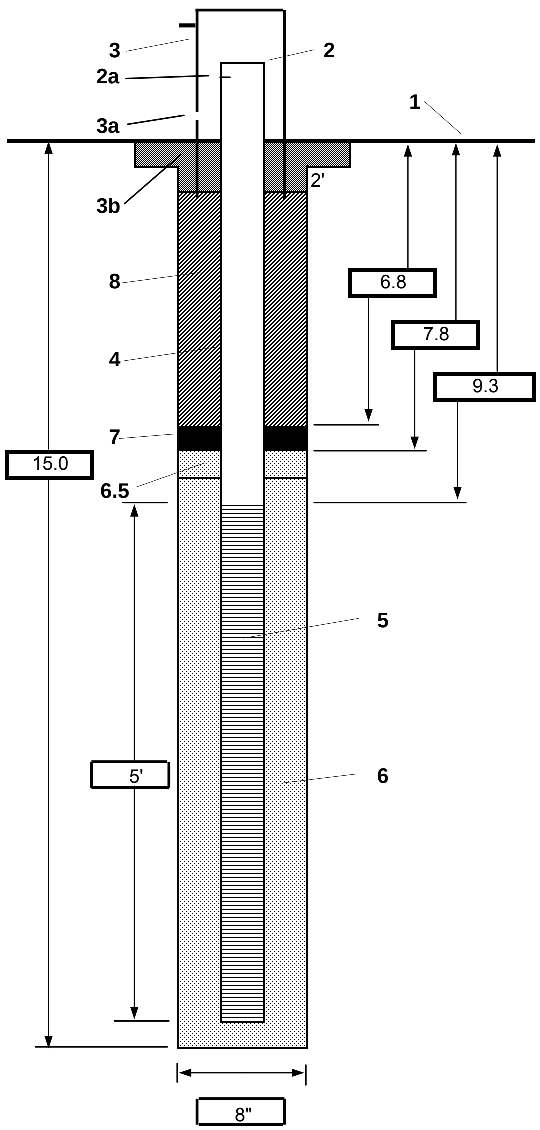
Development time: 1:05

Estimated purge volume: ~ 130 gal

Comments

CH2MHILL	**PROJECT NUMBER** 348136.TT.01	**WELL NUMBER** **IW-402** SHEET 1 OF 1
	WELL COMPLETION DIAGRAM	

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.62 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :



1- Ground elevation at well 585.93

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 2-phase Tempest Pump attached
to 1" SCH 40 PVC riser

Development time 1:00

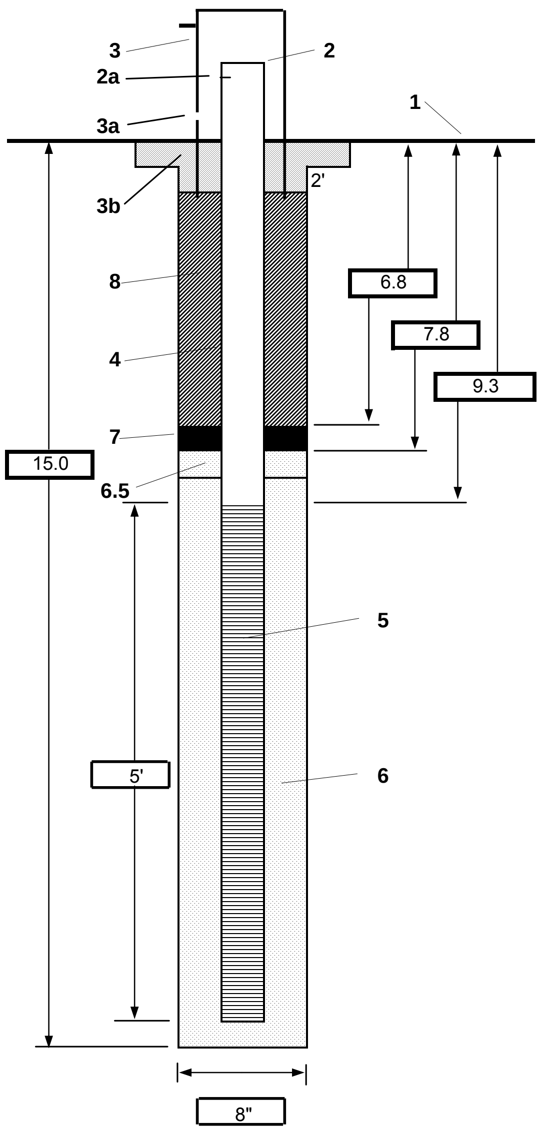
Estimated purge volume ~ 120 gal

Comments

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-403** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.81 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :

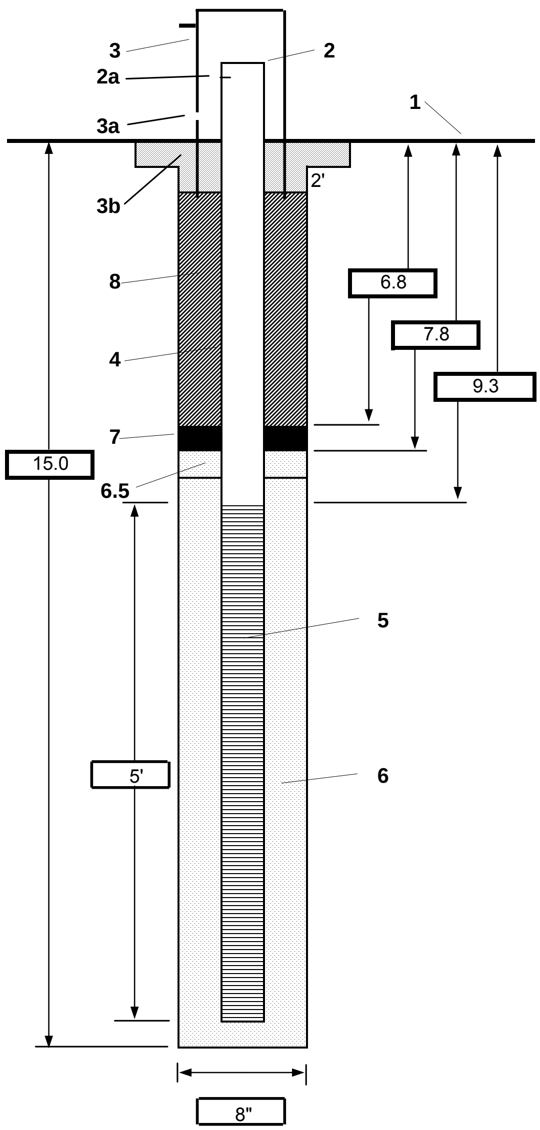


1- Ground elevation at well	585.76
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	2-phase Tempest Pump attached to 1" SCH 40 PVC riser
Development time	1:20
Estimated purge volume	~ 160 gal
Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-404** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/22/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.00 ft bgs START : 2/22/2007 END: 2/22/2007 LOGGER :



1- Ground elevation at well 585.28

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 2-phase Tempest Pump attached
to 1" SCH 40 PVC riser

Development time 1:25

Estimated purge volume ~ 170 gal

Comments

CH2MHILL

PROJECT NUMBER	WELL NUMBER	
348136.TT.01	IW-405	SHEET 1 OF 1

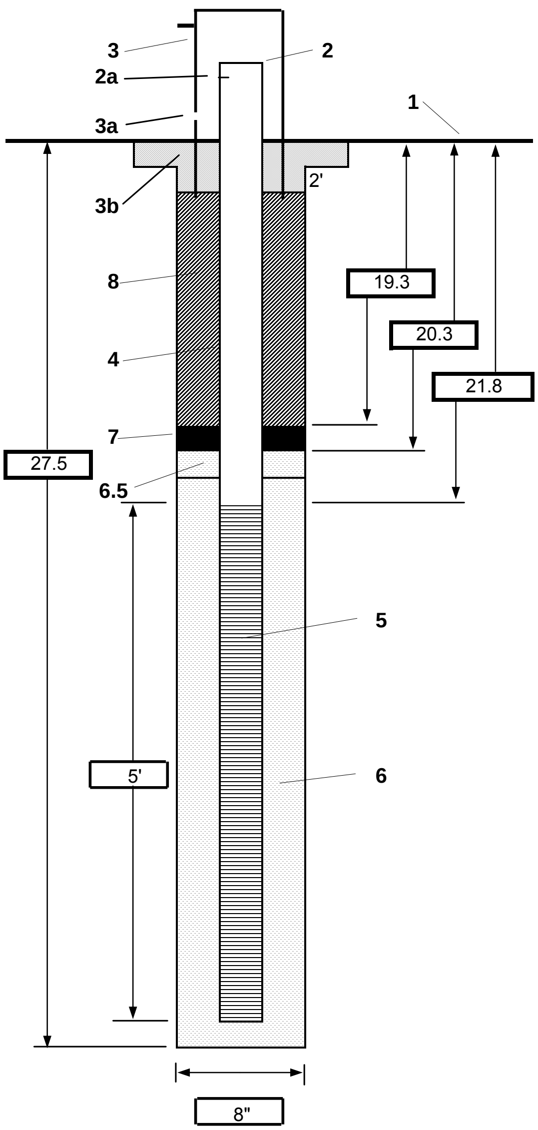
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/26/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 4.62 ft bgs START : 2/26/2007 END: 2/26/2007 LOGGER : I. Mueller

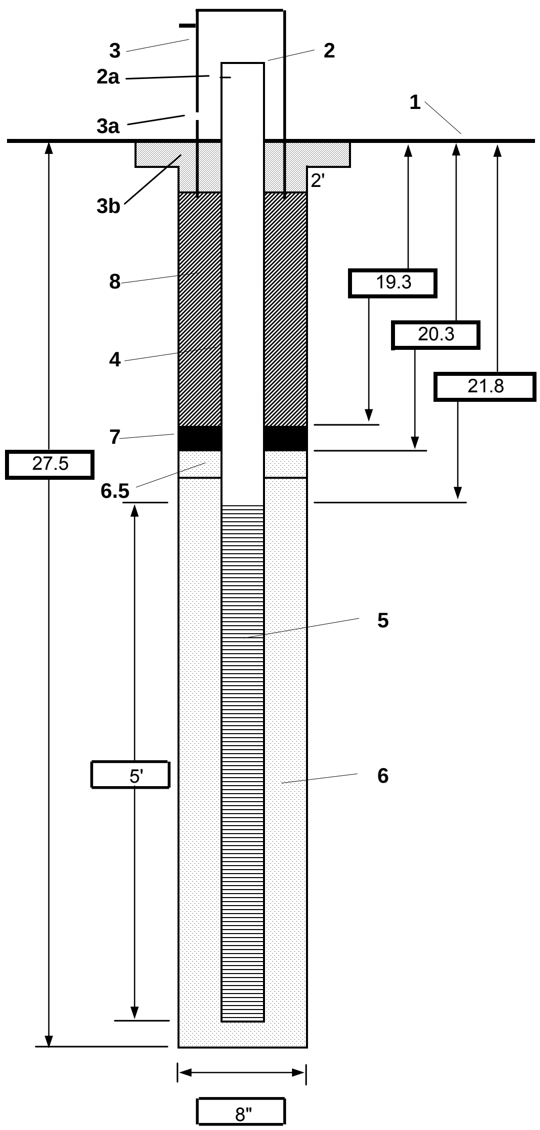


1- Ground elevation at well	586.79
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	1:05
Estimated purge volume	~ 130 gal
Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-406** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/23/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 4.41 ft bgs START : 2/23/2007 END: 2/23/2007 LOGGER :



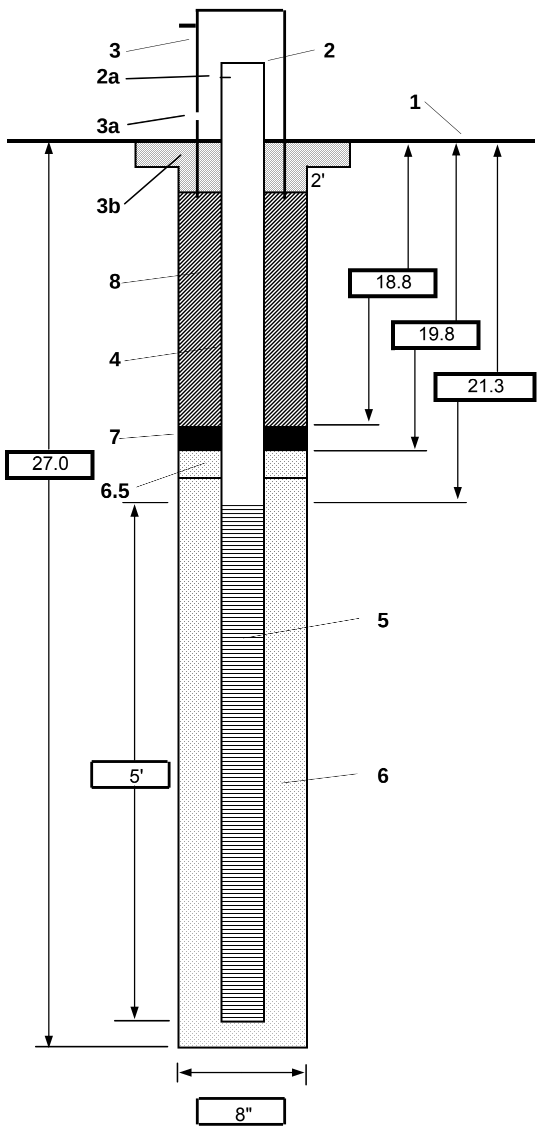
1-	Ground elevation at well	586.40
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel 0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
	Development time	1:05
	Estimated purge volume	~ 130 gal
	Comments	

CH2MHILL

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-407** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/23/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 4.06 ft bgs START : 2/23/2007 END: 2/23/2007 LOGGER :



1- Ground elevation at well: 586.15

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:25

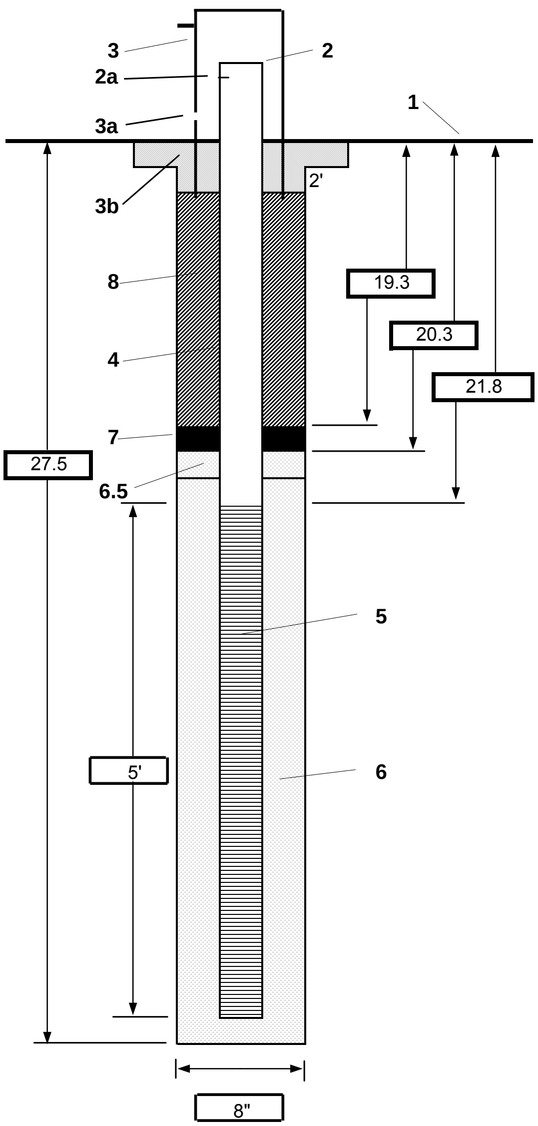
Estimated purge volume: ~ 170 gal

Comments

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-408** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/23/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.94 ft bgs START : 2/23/2007 END: 2/23/2007 LOGGER :

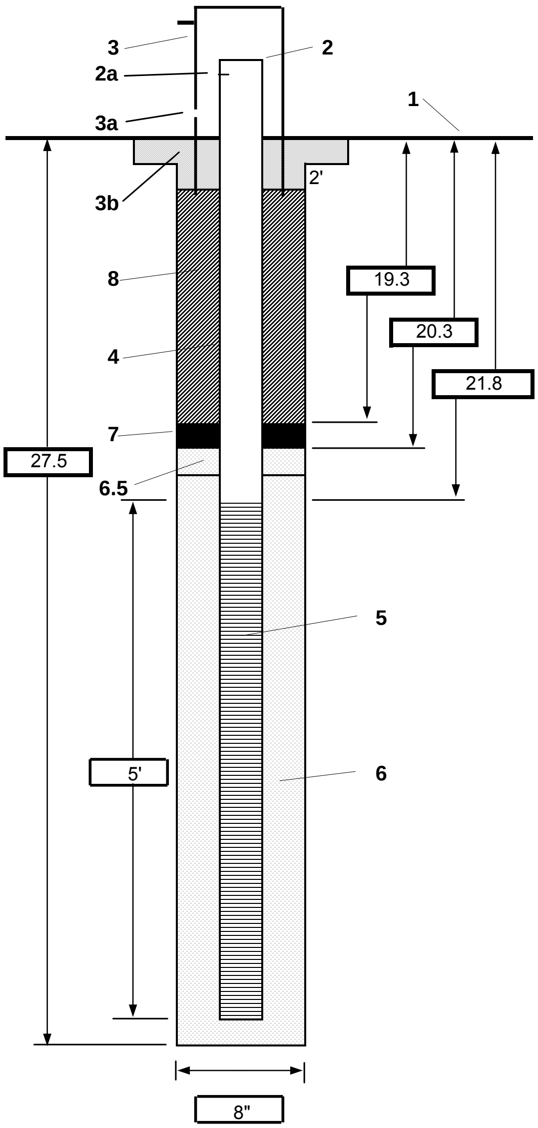


1-	Ground elevation at well	585.87
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel 0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
	Development time	1:30
	Estimated purge volume	~ 180 gal
	Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-409** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.52 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :



1- Ground elevation at well 585.45

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:25

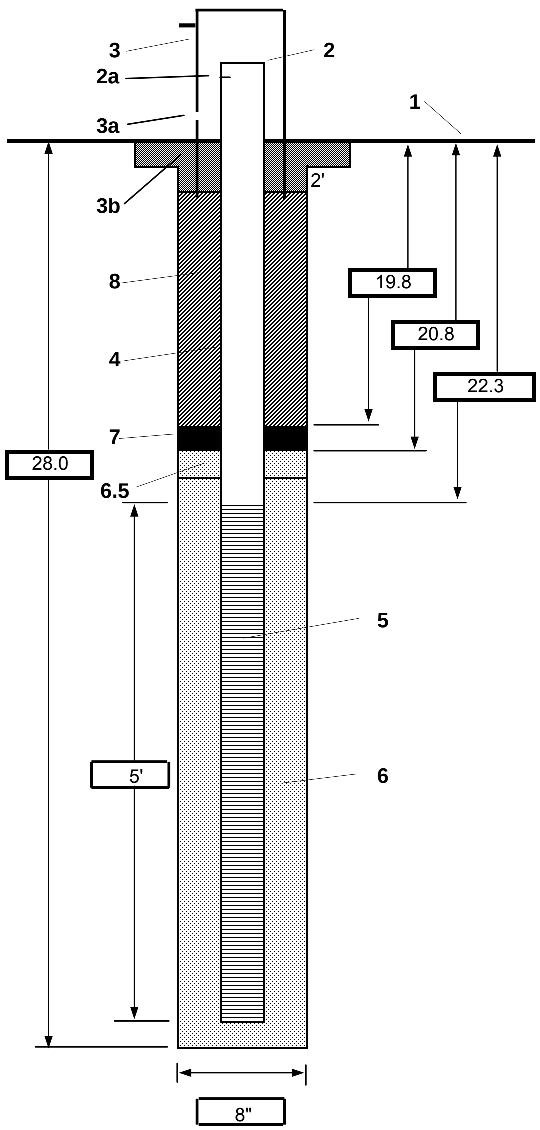
Estimated purge volume ~ 170 gal

Comments

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-410** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/22/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 4.42 ft bgs START 2/22/2007: END: 2/22/2007 LOGGER :



1- Ground elevation at well: 586.75

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:05

Estimated purge volume: ~ 130 gal

Comments

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-411** SHEET 1 OF 1

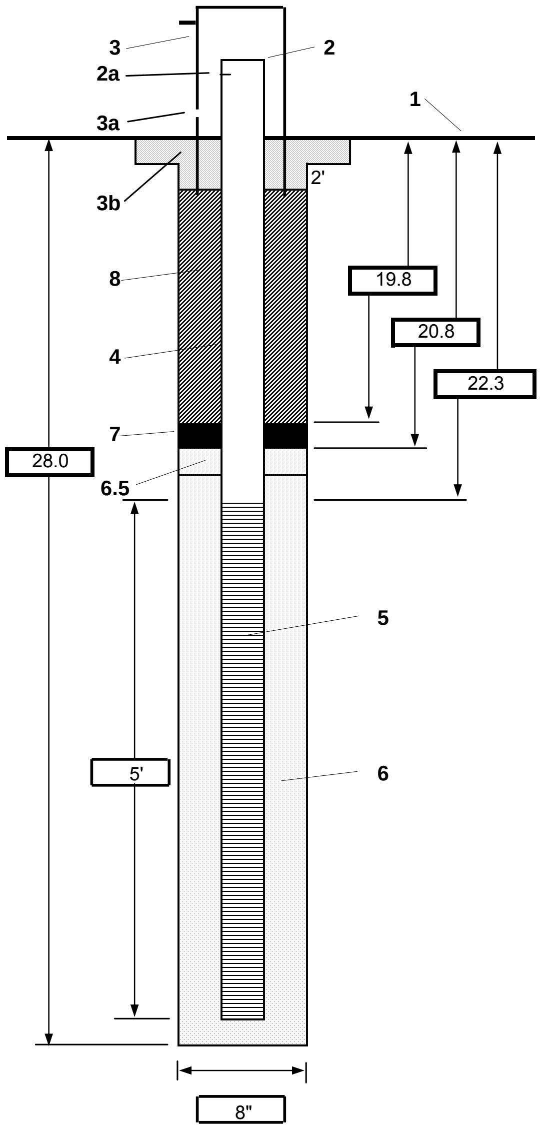
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/22/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 4.53 ft bgs START : 2/22/2007 END: 2/22/2007 LOGGER :



1- Ground elevation at well	586.41
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel 0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	1:15
Estimated purge volume	~ 150 gal
Comments	

	PROJECT NUMBER	WELL NUMBER		
CH2MHILL	348136.TT.01	IW-412	SHEET 1	OF 1

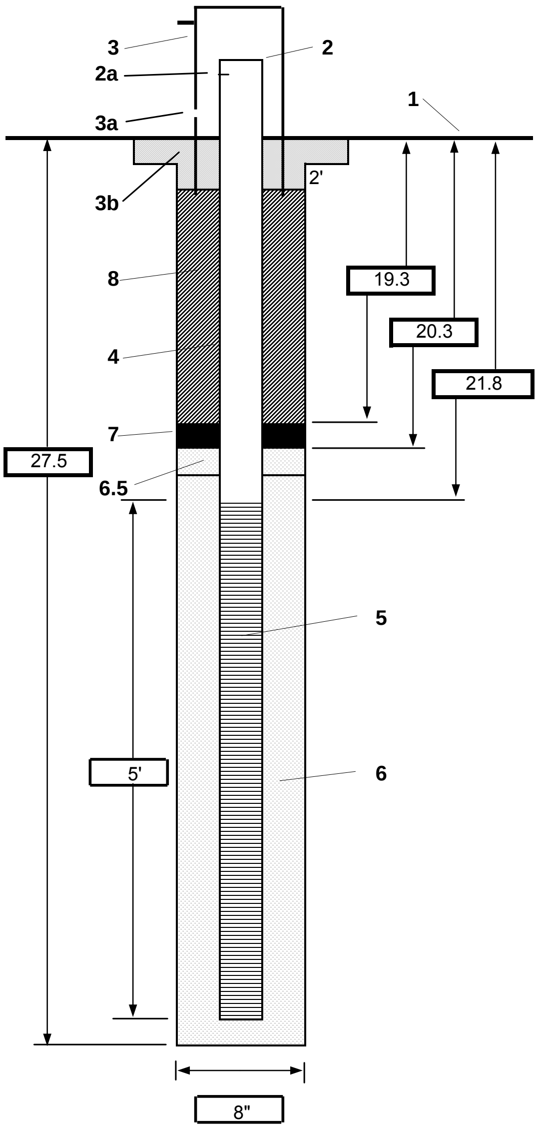
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 3.90 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :



1-	Ground elevation at well	586.02
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel
		0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
	Development time	1:30
	Estimated purge volume	~ 180 gal
	Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-413** SHEET 1 OF 1

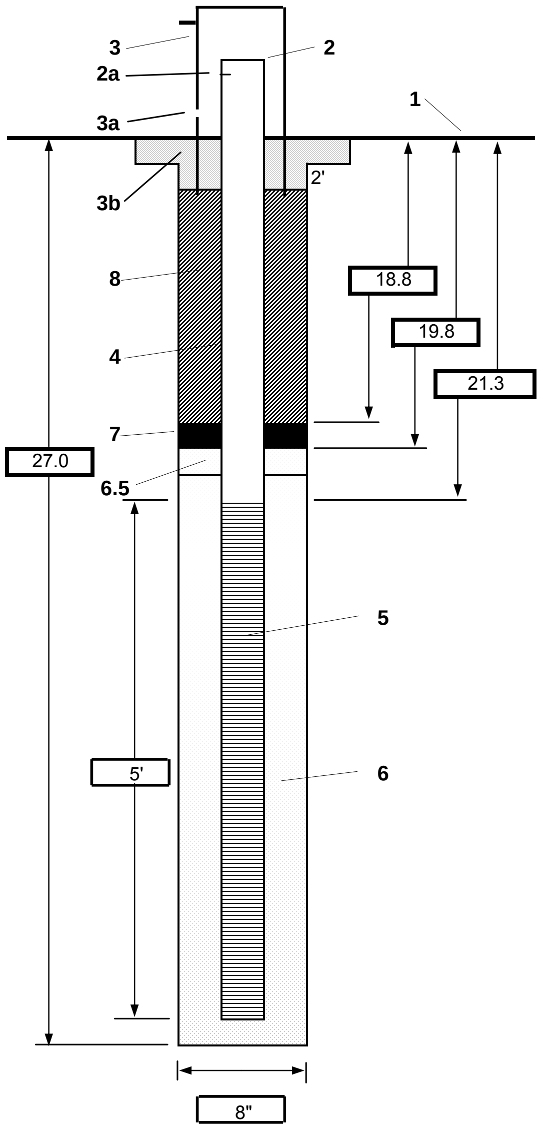
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/21/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 3.42 ft bgs START : 2/21/2007 END: 2/21/2007 LOGGER :



1- Ground elevation at well: 585.56

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached
to 1" SCH 40 PVC riser

Development time: 1:25

Estimated purge volume: ~ 170 gal

Comments

	PROJECT NUMBER	WELL NUMBER		
CH2MHILL	348136.TT.01	**IW-414**	SHEET 1	OF 1

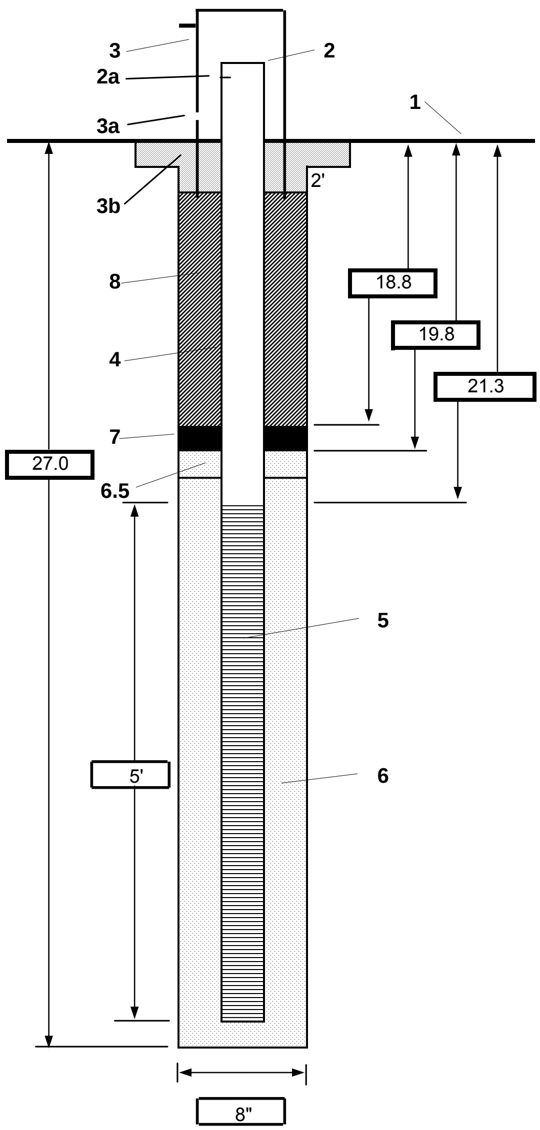
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/22/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 2.42 ft bgs START : 2/22/2007 END: 2/22/2007 LOGGER :



1- Ground elevation at well: 584.31

2- Top of casing elevation:
  a) vent hole?: None

3- Wellhead protection cover type: Flush mount
  a) weep hole?: None
  b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
  0.010" slot

6- Type screen filter: #5 quartz sand filter pack
  a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
  a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
  a) Grout mix used: Portland cement/bentonite
  b) Method of placement: Tremie pipe
  c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:20

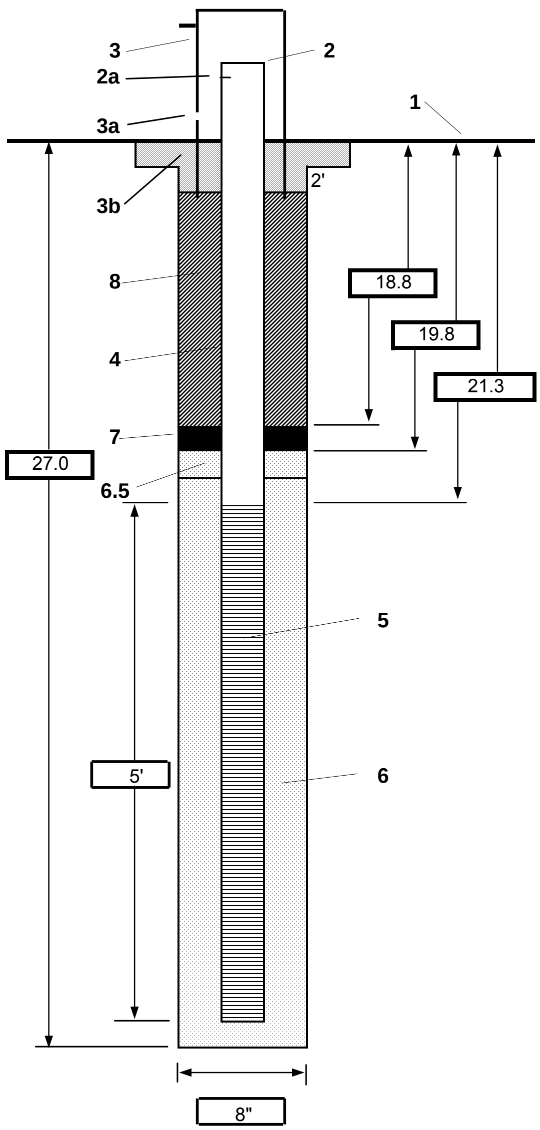
Estimated purge volume: ~ 160 gal

Comments:

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-415** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/27/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 3.92 ft bgs START : 15:20 END: 17:00 LOGGER : I. Mueller



1- Ground elevation at well	586.00
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel 0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	1:05
Estimated purge volume	~ 130 gal
Comments	

	PROJECT NUMBER	WELL NUMBER	
CH2MHILL	348136.TT.01	**IW-416**	SHEET 1 OF 1

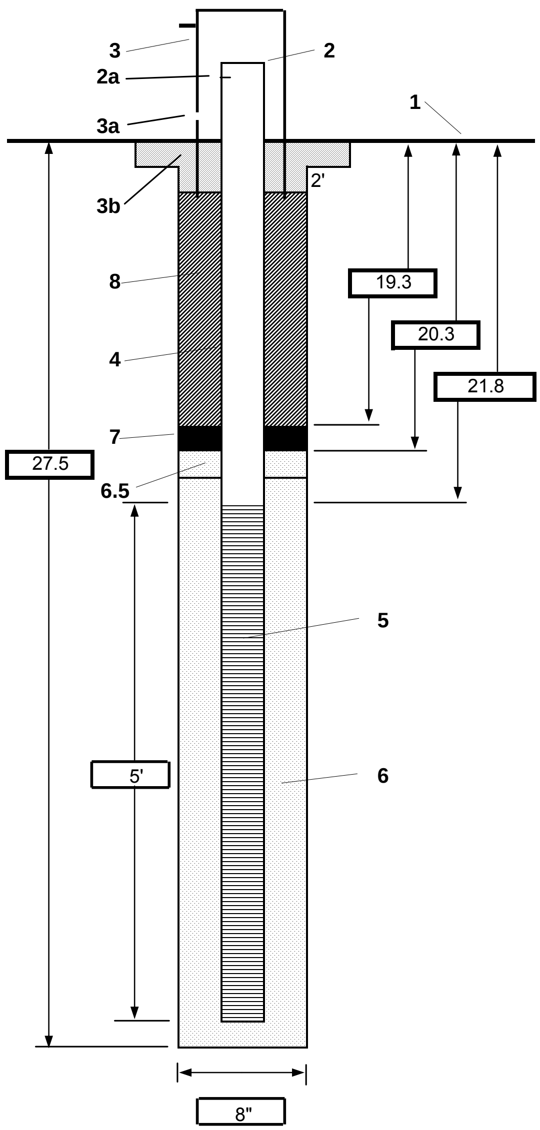
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/26/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 4.21 ft bgs START : 2/26/2007 END: 2/26/2007 LOGGER : I. Mueller

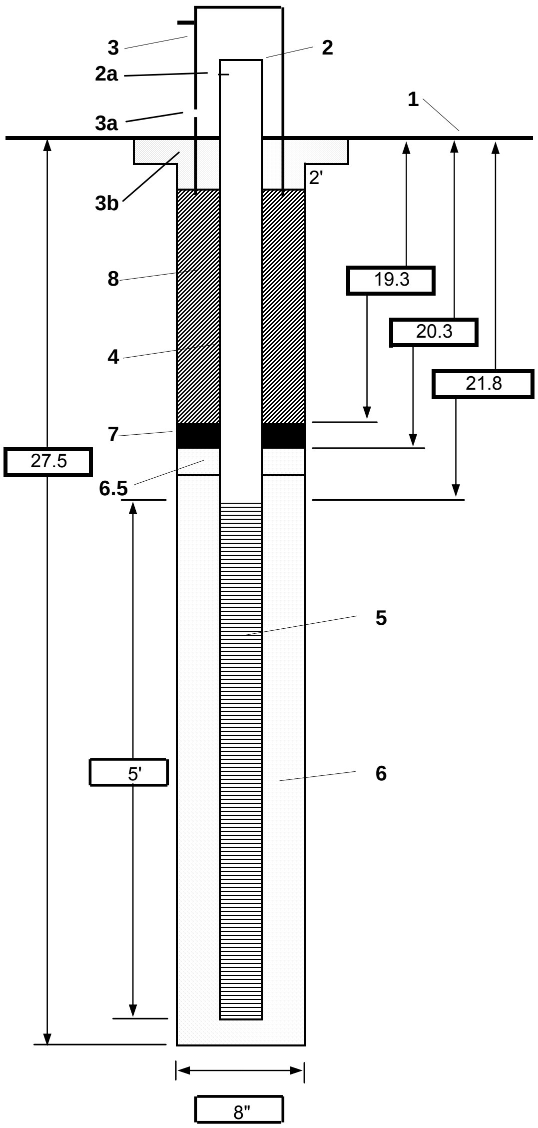


1-	Ground elevation at well	585.95
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel 0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
	Development time	1:25
	Estimated purge volume	~ 170 gal
	Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER IW-417 SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/27/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 4.11 ft bgs START : 10:15 END: 12:45 LOGGER : I. Mueller



1- Ground elevation at well 585.88

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:30

Estimated purge volume ~ 150 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-418 SHEET 1 OF 1

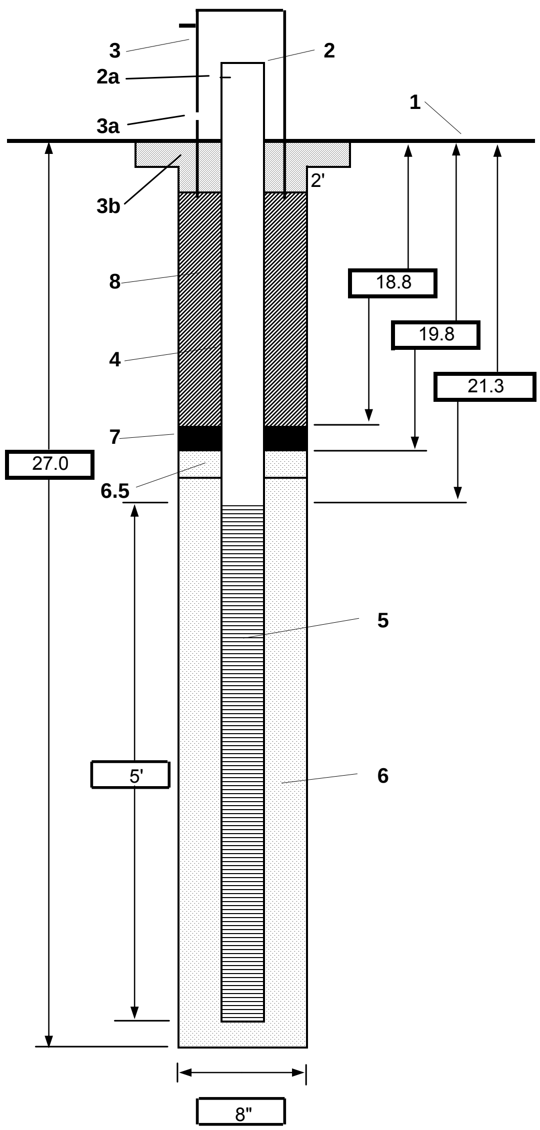
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/28/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 3.82 ft bgs START : 8:00 END: 9:30 LOGGER : I. Mueller

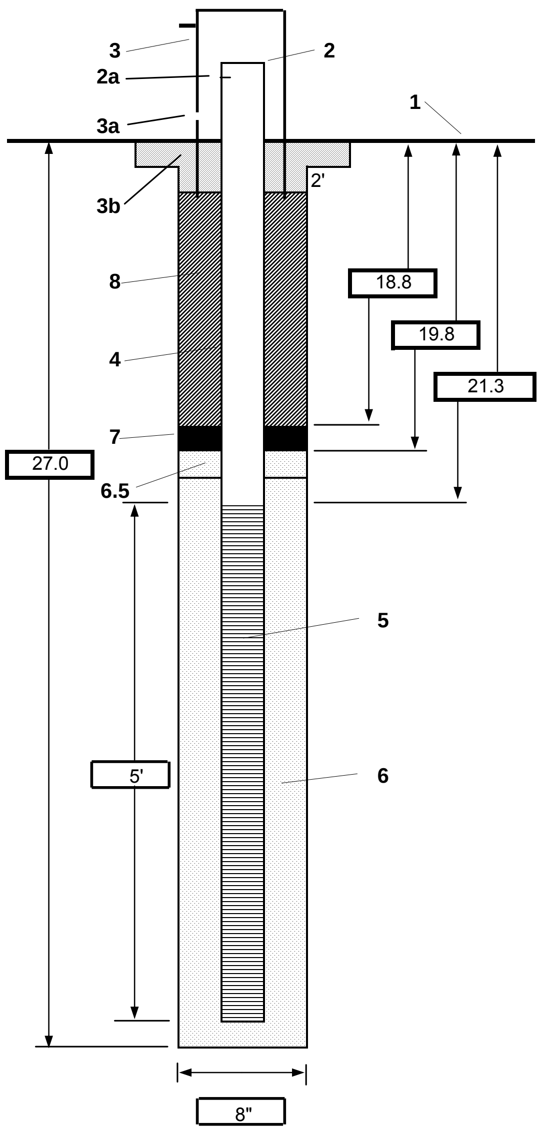


1- Ground elevation at well	585.45
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel 0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	3:55
Estimated purge volume	~ 210 gal
Comments	

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-419** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/28/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.56 ft bgs START : 9:30 END: 12:00 LOGGER : I. Mueller



1- Ground elevation at well: 584.96

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 3:15

Estimated purge volume: ~240 gal

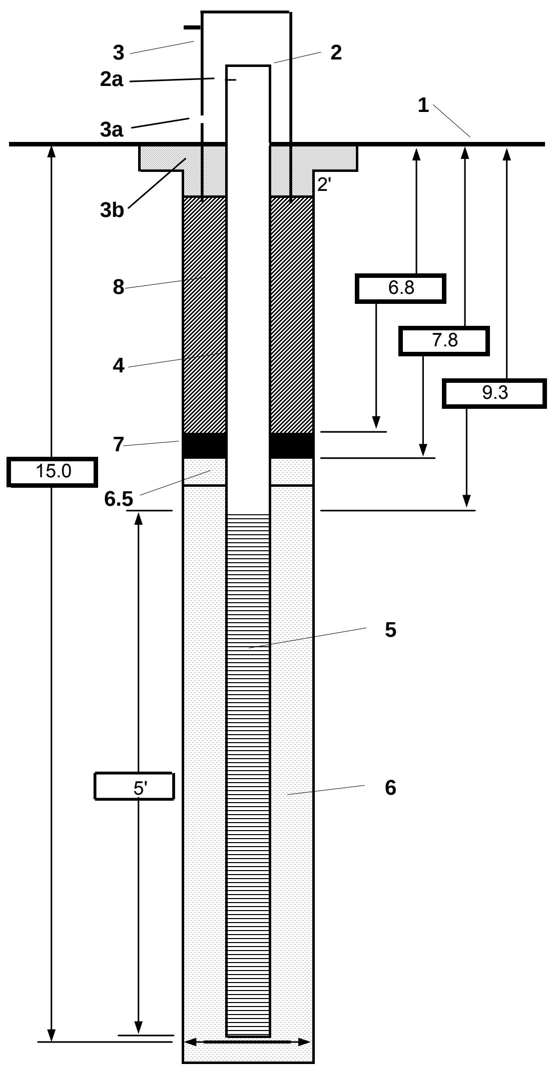
Comments

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-500**	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/4/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.78 ft bgs START : END: 16:00 LOGGER : E. Molander



1- Ground elevation at well 588.36

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 2-phase Tempest Pump attached
to 1" SCH 40 PVC riser

Development time 1:05

Estimated purge volume ~130 gal

Comments

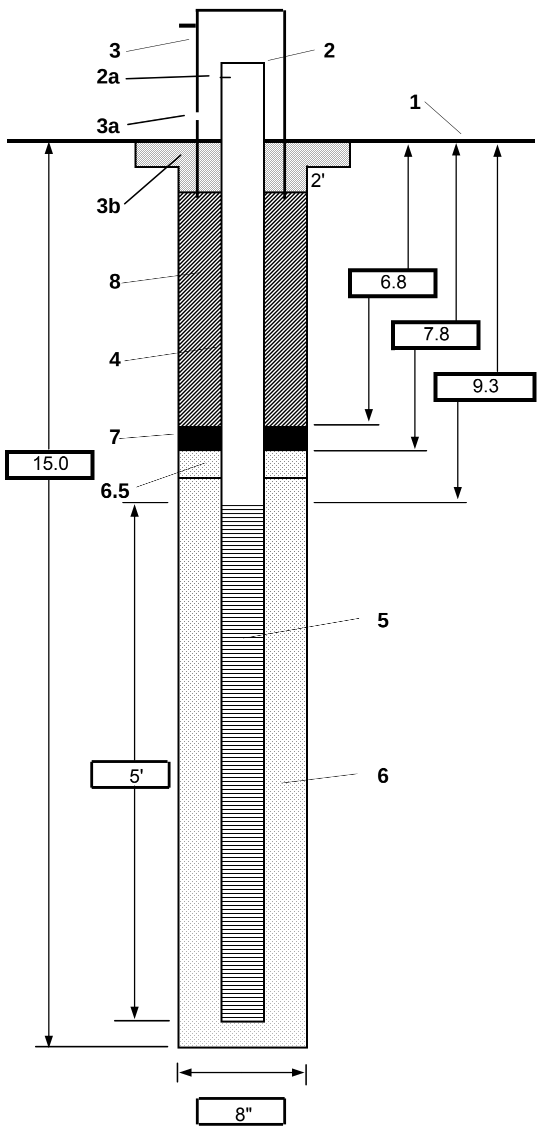
CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-501** SHEET 1 OF 1
	WELL COMPLETION DIAGRAM	

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/4/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.66 ft bgs START : 1/4/2007 END: 1/4/2007 LOGGER : E. Molander



1- Ground elevation at well: 588.27

2- Top of casing elevation:
 a) vent hole?: None

3- Wellhead protection cover type: Flush mount
 a) weep hole?: None
 b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
 0.010" slot

6- Type screen filter: #5 quartz sand filter pack
 a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
 a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
 a) Grout mix used: Portland cement/bentonite
 b) Method of placement: Tremie pipe
 c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 0:55

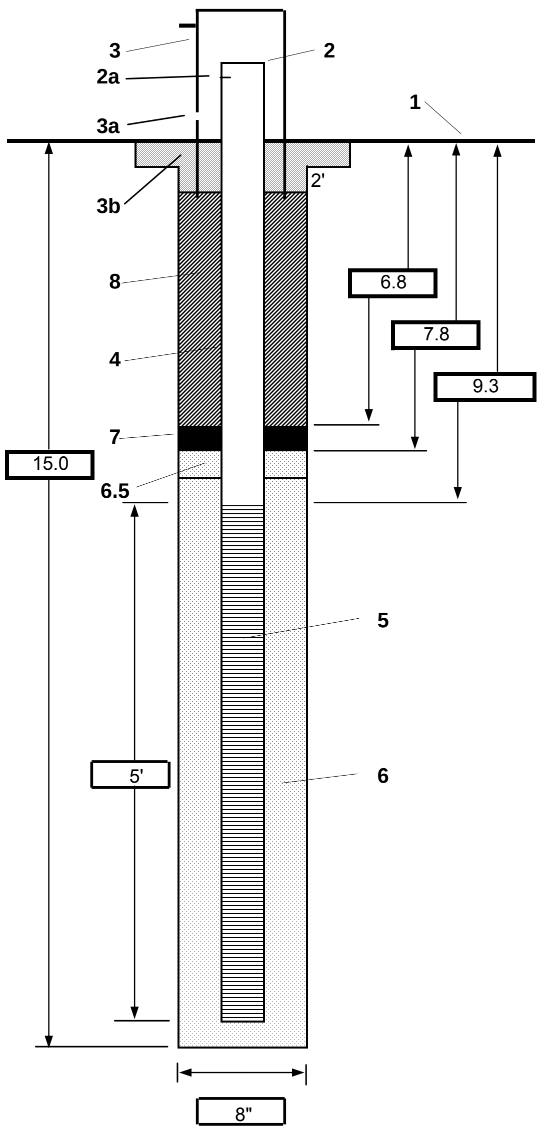
Estimated purge volume: ~110 gal

Comments

CH2MHILL	**PROJECT NUMBER** 348136.TT.01	**WELL NUMBER** **IW-502** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/4/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : START : 1/4/2007 END: 1/4/2007 LOGGER : E. Molander



1- Ground elevation at well: 588.28

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached
to 1" SCH 40 PVC riser

Development time: 1:05

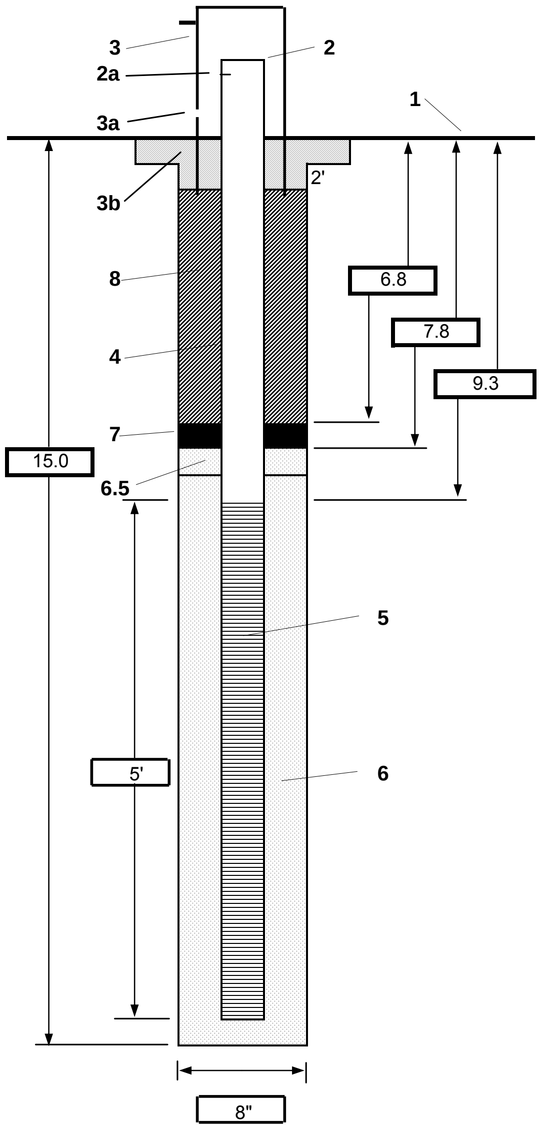
Estimated purge volume: ~170 gal

Comments

	PROJECT NUMBER	WELL NUMBER		
CH2MHILL	348136.TT.01	IW-503	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/4/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : START : 1/4/2007 END: 1/4/2007 LOGGER : E. Molander



1- Ground elevation at well: 588.25

2- Top of casing elevation:
  a) vent hole?: None

3- Wellhead protection cover type: Flush mount
  a) weep hole?: None
  b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
  0.010" slot

6- Type screen filter: #5 quartz sand filter pack
  a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
  a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
  a) Grout mix used: Portland cement/bentonite
  b) Method of placement: Tremie pipe
  c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 1:30

Estimated purge volume: ~180 gal

Comments

CH2MHILL	PROJECT NUMBER 348136.TT.01	WELL NUMBER **IW-504** SHEET 1 OF 1

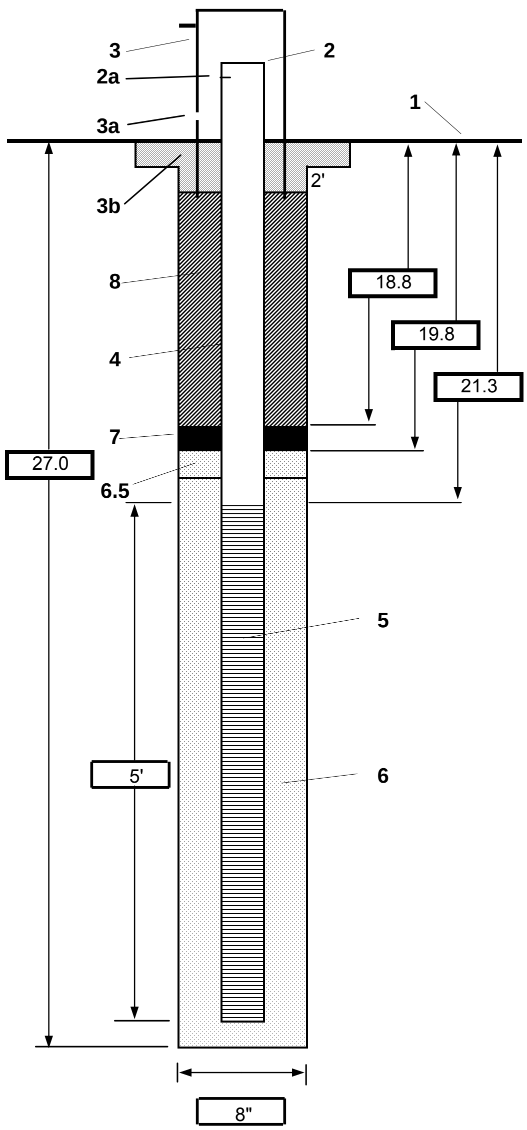
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/17/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.59 ft bgs START : 13:05 END : 14:40 LOGGER : VBR



1- Ground elevation at well	588.26
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	1:30
Estimated purge volume	~180 gal
Comments	

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-505 SHEET 1 OF 1

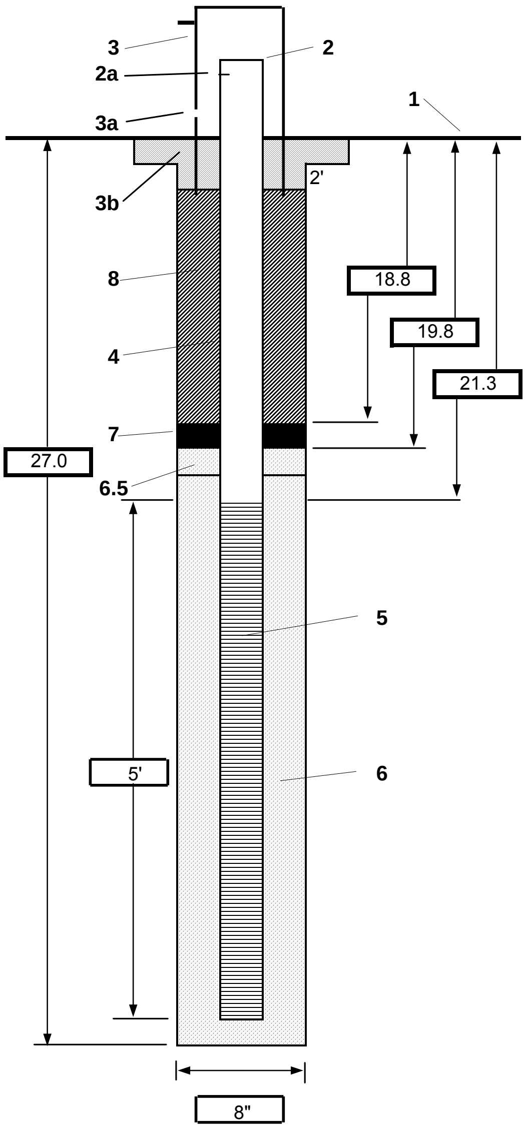
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/18/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.68 ft bgs START : 7:45 END : 10:45 LOGGER : E. Molander



1- Ground elevation at well	588.35
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
Development time	1:25
Estimated purge volume	~170 gal
Comments	

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-505 SHEET 1 OF 1

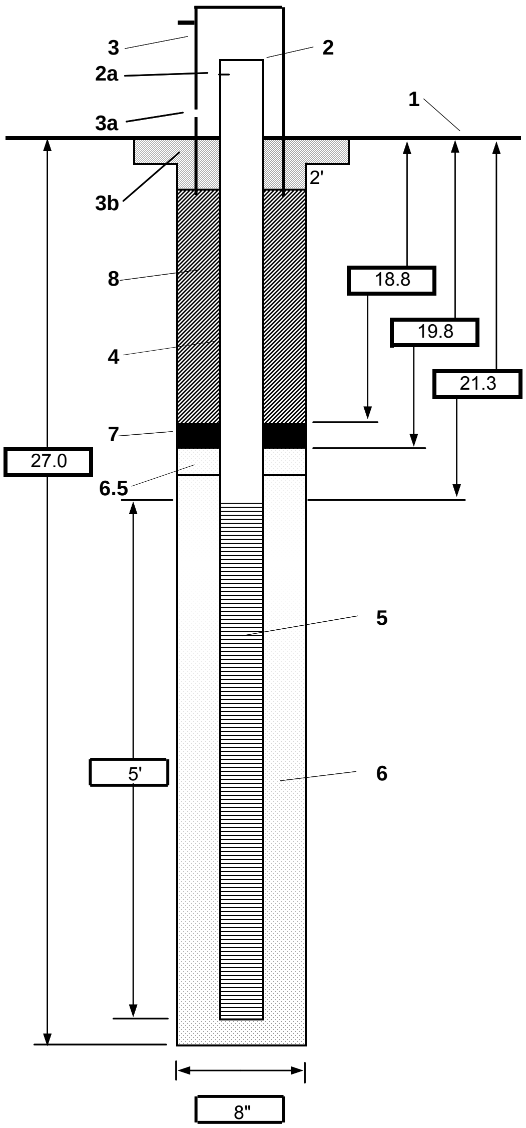
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/17/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.68 ft bgs START : 9:15 END : 10:40 LOGGER : VBR



1- Ground elevation at well: 588.41

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel, 0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:55

Estimated purge volume: ~230 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-505	SHEET 1	OF 1

CH2MHILL

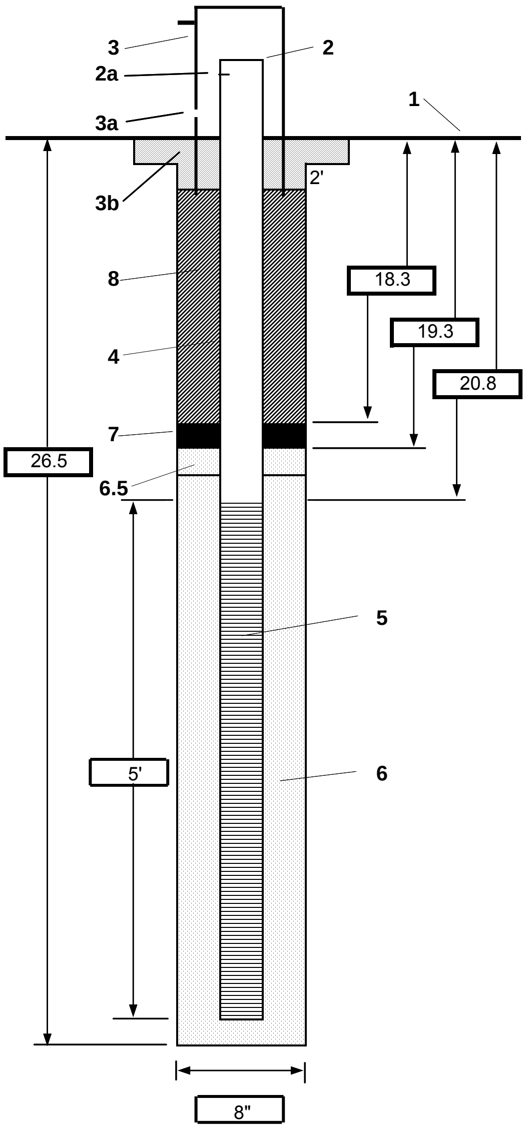
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/16/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.81 ft bgs START : 13:53 END : 15:20 LOGGER : VBR



1- Ground elevation at well: 588.35

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel, 0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:40

Estimated purge volume: ~200 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-508	SHEET 1	OF 1

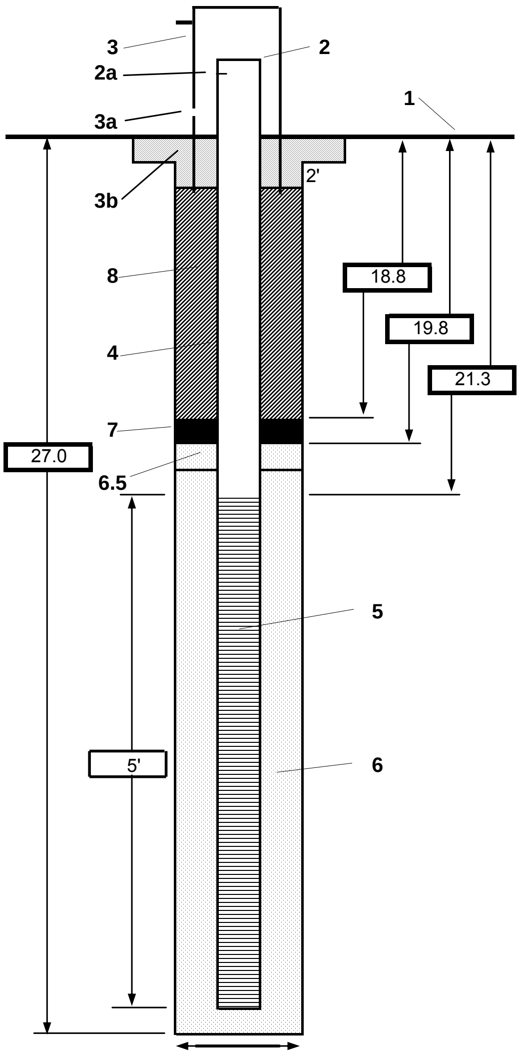
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/18/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : START : 12:40 END : 15:45 LOGGER : E. Molander



1- Ground elevation at well: 588.37

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:15

Estimated purge volume: ~150 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-509	SHEET 1	OF 1

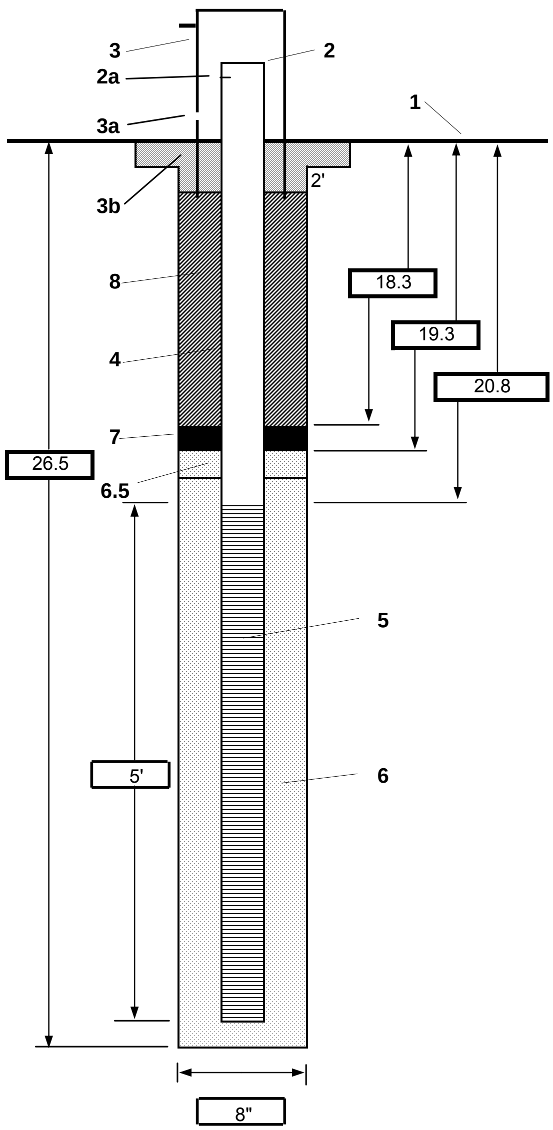
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/18-19/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.64 ft bgs START : 16:00 END : 9:45 LOGGER : E. Molander



1- Ground elevation at well: 588.38

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:30

Estimated purge volume: ~180 gal

Comments:

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-510** SHEET 1 OF 1

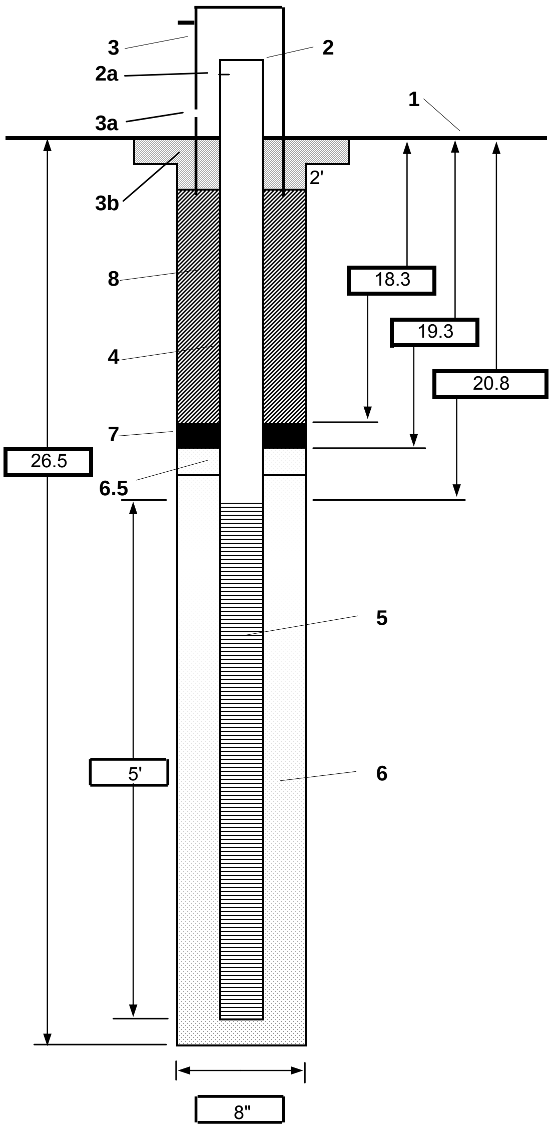
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/19/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.55 ft bgs START : 10:00 END : 11:00 LOGGER : E. Molander



1- Ground elevation at well	588.40
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	3-phase Mini-Monsoon Pump attached
	to 1" SCH 40 PVC riser
Development time	1:30
Estimated purge volume	~180 gal
Comments	

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-511 SHEET 1 OF 1

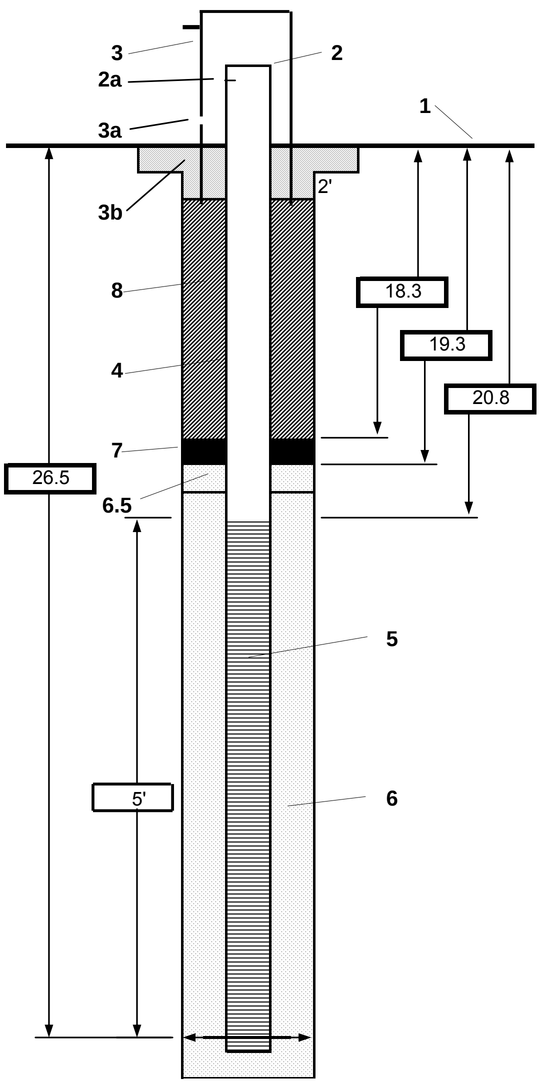
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.72 ft bgs START : 7:50 END: 12:30 LOGGER : E. Molander



1- Ground elevation at well 588.30

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 2:55

Estimated purge volume ~350 gal

Comments Large void below concrete (a few feet). Wood plug broke through bottom; needed to re-advance. Odors coming from soil. Thicker clay layer above till.

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-512	SHEET 1	OF 1

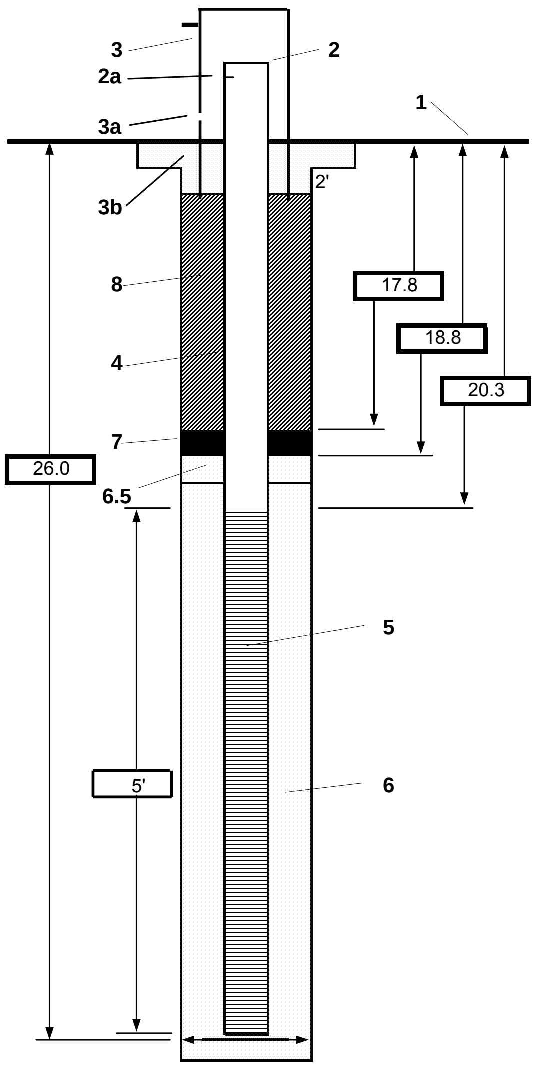
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/22/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.78 ft bgs START : 14:15 END : 17:00 LOGGER : E. Molander



1- Ground elevation at well 588.36

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:55

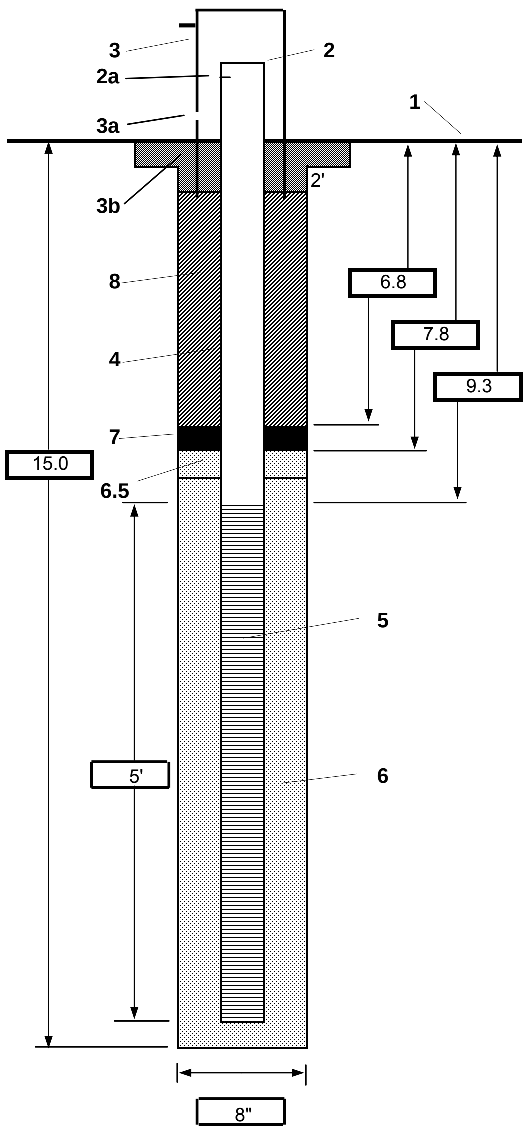
Estimated purge volume ~230 gal

Comments Potentially hit a sewer line. Drillers unsure. A lot of larger pieces of gravel, possibly some concrete. Much wetter in this hole than in nearby holes (e.g. IW-511).

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-513** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/5/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.56 ft bgs START : 9:20 END : 10:30 LOGGER : E. Molander



1- Ground elevation at well: 588.42

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 1:45

Estimated purge volume: ~210 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-514**	SHEET 1	OF 1

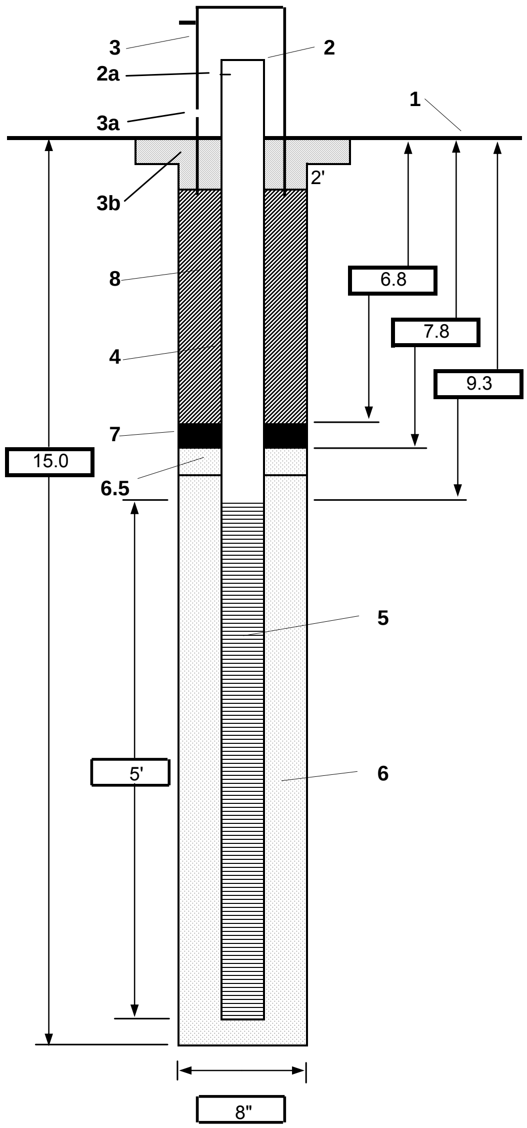
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/5/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.63 ft bgs START : 8:00 END : 9:20 LOGGER : E. Molander



1- Ground elevation at well: 588.32

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel

0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 1:15

Estimated purge volume: ~150 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-515	SHEET 1	OF 1

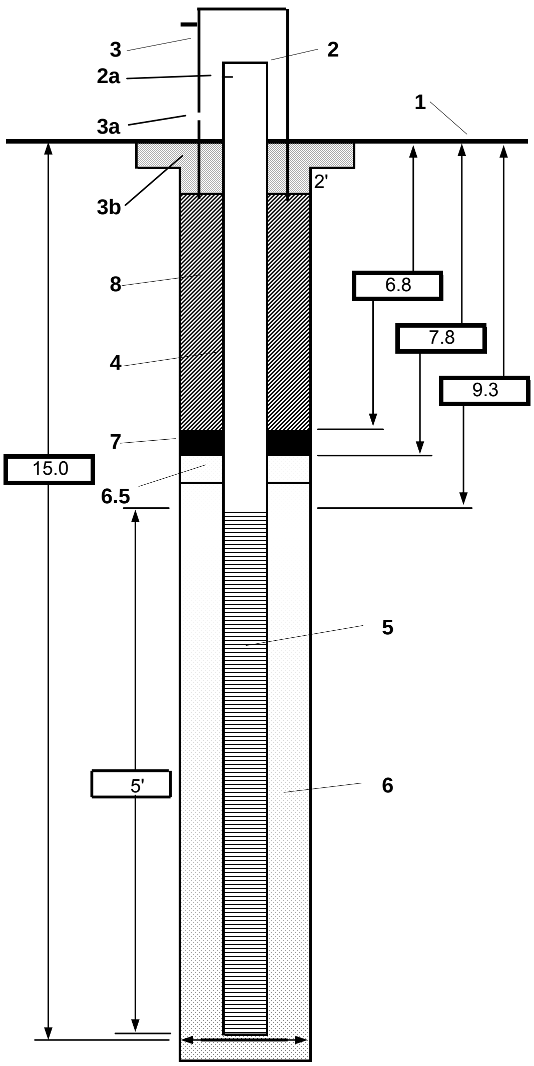
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.25 ft bgs START : 10:00 END : 14:00 LOGGER : E. Molander



1- Ground elevation at well: 588.27

2- Top of casing elevation:
  a) vent hole?: None

3- Wellhead protection cover type: Flush mount
  a) weep hole?: None
  b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
  0.010" slot

6- Type screen filter: #5 quartz sand filter pack
  a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
  a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
  a) Grout mix used: Portland cement/bentonite
  b) Method of placement: Tremie pipe
  c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 1:05

Estimated purge volume: ~130 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-516	SHEET 1	OF 1

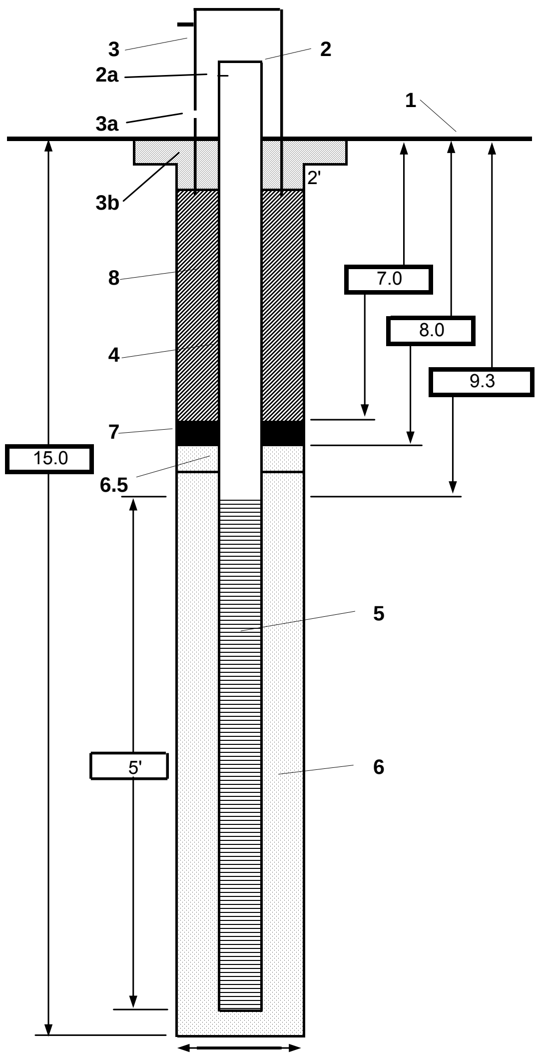
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.32 ft bgs START : 15:00 END : 16:15 LOGGER E. Molander



1- Ground elevation at well	588.40
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	2-phase Tempest Pump attached to 1" SCH 40 PVC riser
Development time	0:40
Estimated purge volume	~80 gal
Comments	

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-517	SHEET 1	OF 1

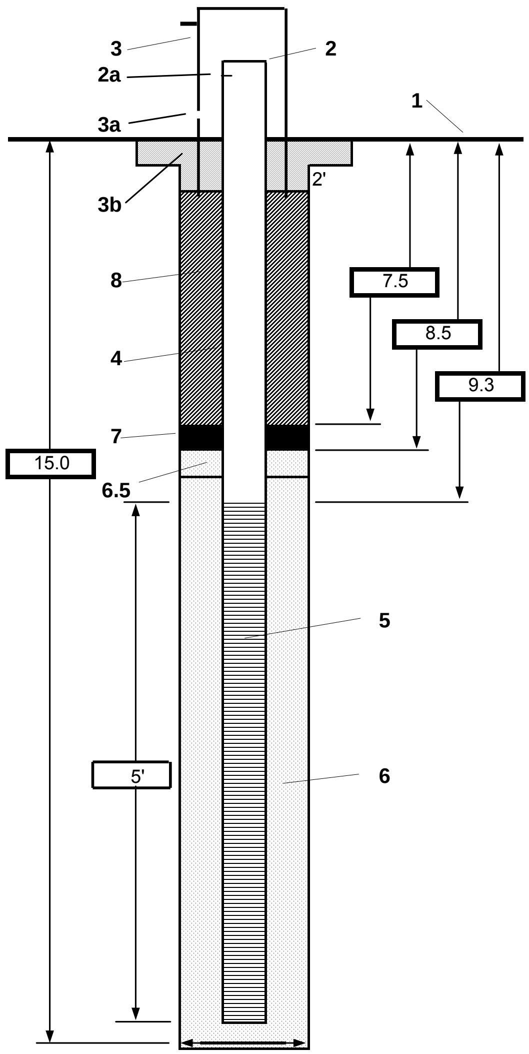
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.46 ft bgs START : 8:00 END: 9:30 LOGGER : E. Molander



1-	Ground elevation at well	588.37
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel 0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	2-phase Tempest Pump attached to 1" SCH 40 PVC riser
	Development time	0:30
	Estimated purge volume	~50 gal
	Comments	

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-518	SHEET 1	OF 1

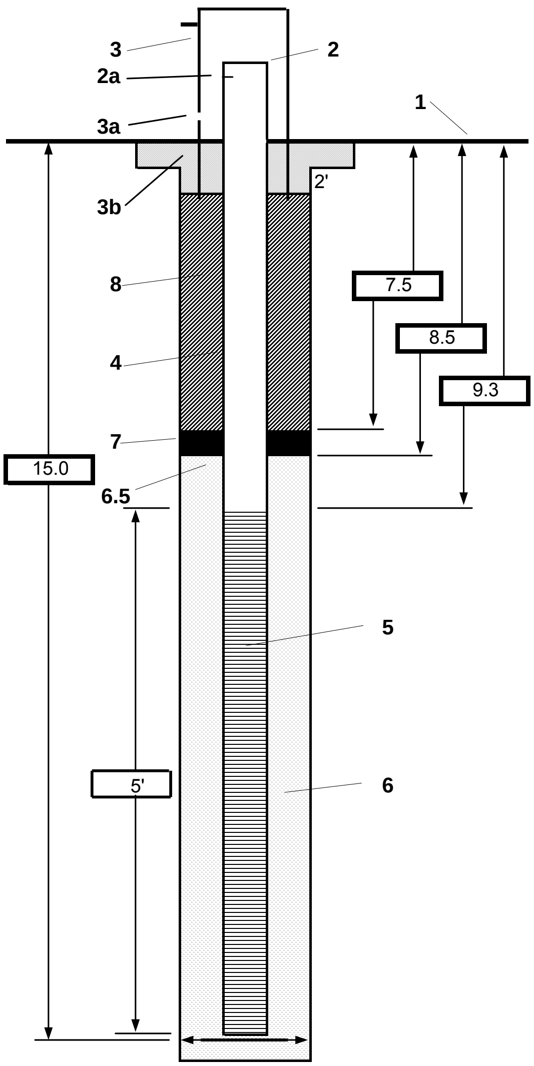
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.40 ft bgs START : 9:30 END: 10:45 LOGGER : E. Molander



1- Ground elevation at well	588.39
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	12" diameter
4- Dia./type of well casing	2" Sch 40 PVC
5- Type/slot size of screen	2" stainless steel 0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	~1/4 of 5-gal bucket
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie pipe
c) Vol. of well casing grout	
Development method	2-phase Tempest Pump attached to 1" SCH 40 PVC riser
Development time	1:10
Estimated purge volume	~ 120 gal
Comments	

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-519 SHEET 1 OF 1

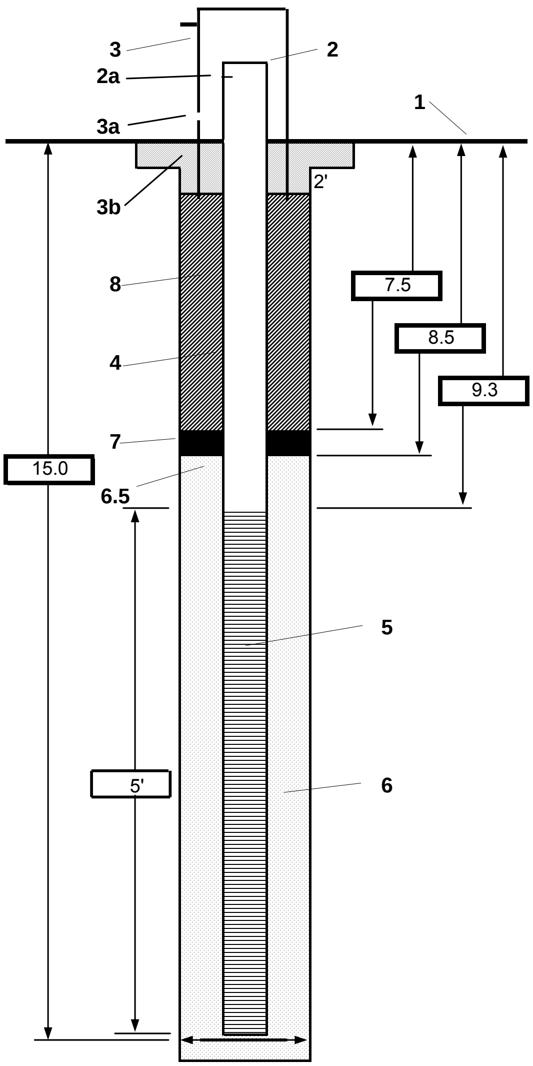
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.51 ft bgs START : 11:00 END: 12:00 LOGGER : E. Molander

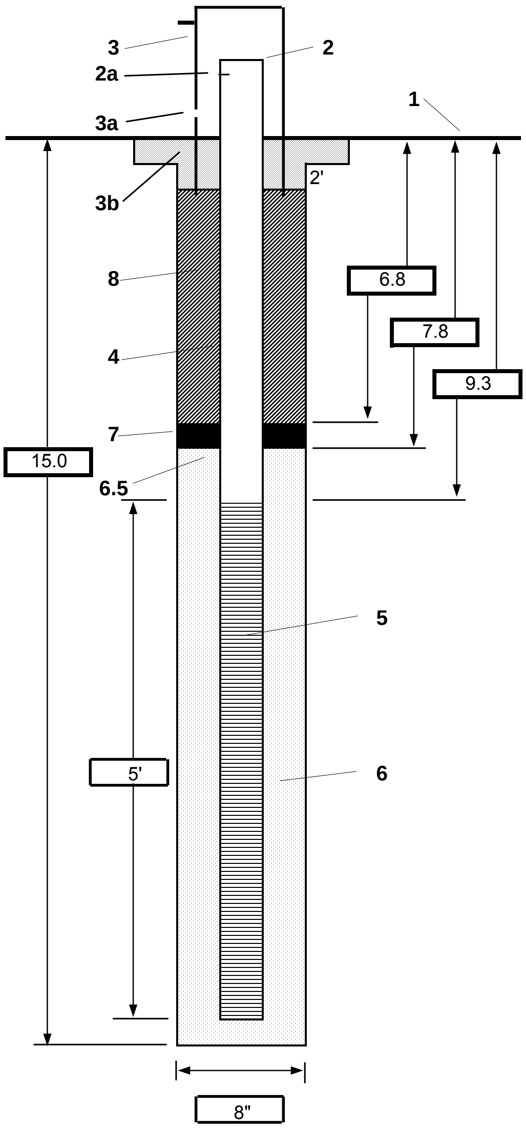


1-	Ground elevation at well	588.41
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel
		0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	2-phase Tempest Pump attached
		to 1" SCH 40 PVC riser
	Development time	0:55
	Estimated purge volume	~110 gal
	Comments	

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-520** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.56 ft bgs START : 13:45 END: 15:00 LOGGER : E. Molander



1- Ground elevation at well 588.40

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 2-phase Tempest Pump attached
to 1" SCH 40 PVC riser

Development time 1:00

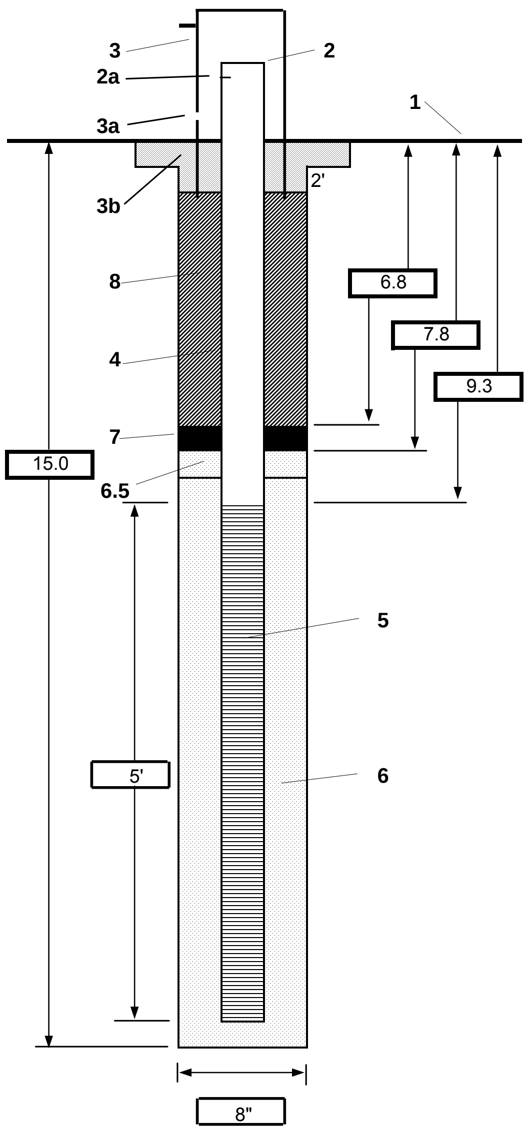
Estimated purge volume ~120 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-521** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.49 ft bgs START : 15:15 END : 16:00 LOGGER : E. Molander



1- Ground elevation at well: 588.40

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand
7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~ 1/4 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 2-phase Tempest Pump attached to 1" SCH 40 PVC riser

Development time: 0:45

Estimated purge volume: ~90 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-522**	SHEET 1	OF 1

CH2MHILL

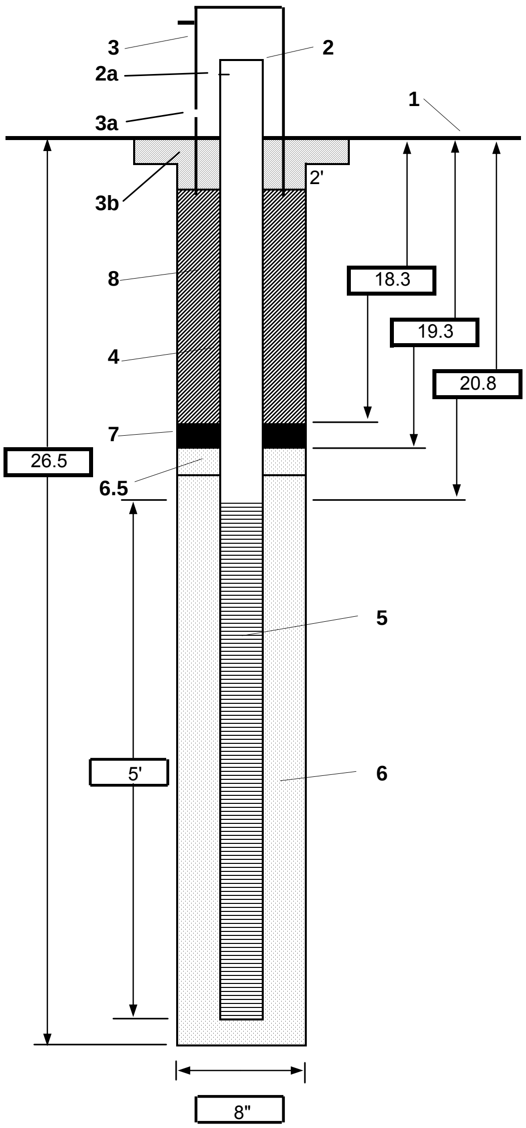
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/15/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.74 ft bgs START : 14:40 END : 15:50 LOGGER : VBR



1- Ground elevation at well: 588.39

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~ 1/4 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:55

Estimated purge volume: ~230 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-523	SHEET 1	OF 1

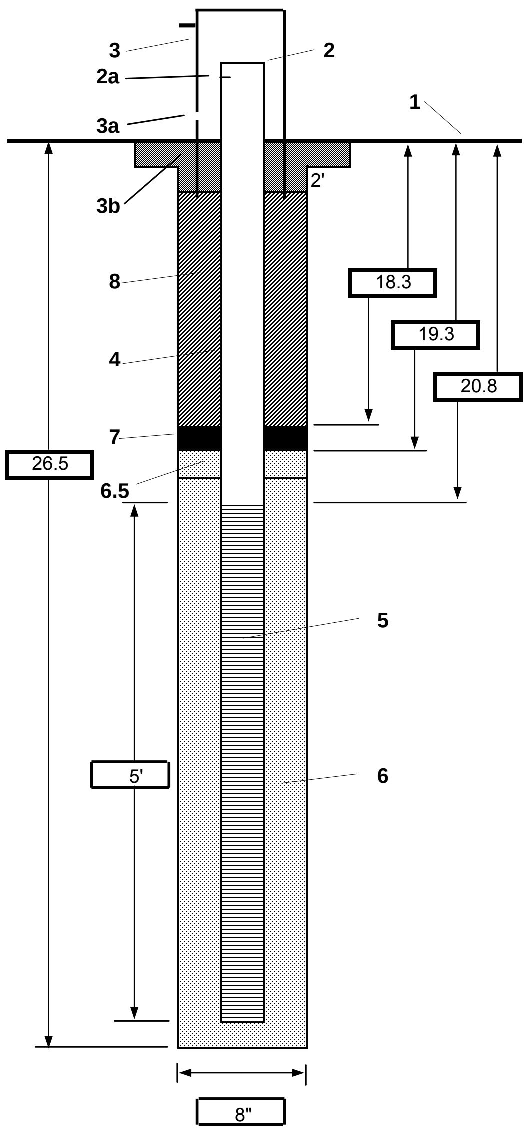
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.58 ft bgs START : 9:25 END : 10:25 LOGGER : VBR



1- Ground elevation at well 588.41

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~ 1/4 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:50

Estimated purge volume ~220 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-524** SHEET 1 OF 1

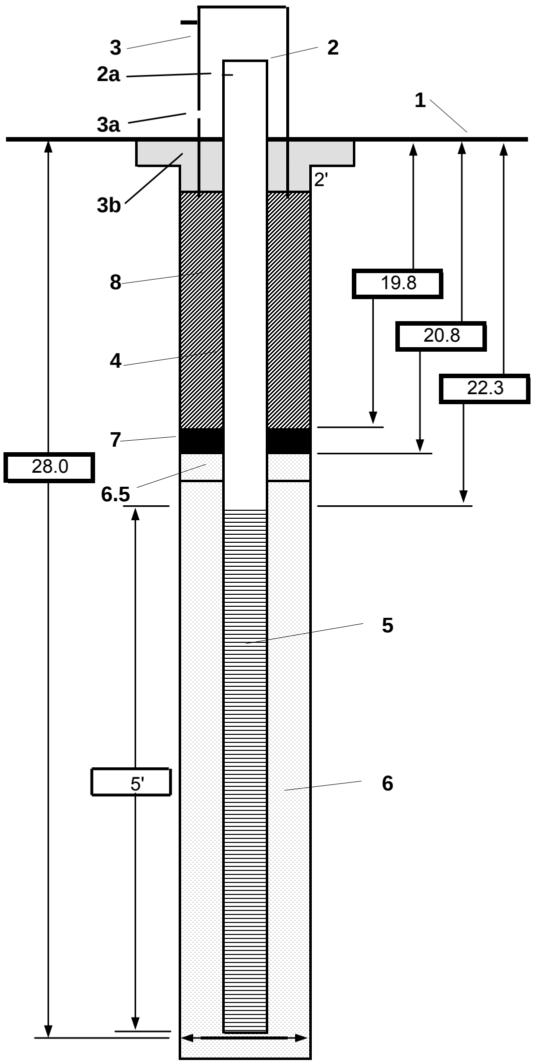
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.35 ft bgs START : 9:00 END : 10:30 LOGGER : E. Molander



1-	Ground elevation at well	588.35
2-	Top of casing elevation	
	a) vent hole?	None
3-	Wellhead protection cover type	Flush mount
	a) weep hole?	None
	b) concrete pad dimensions	12" diameter
4-	Dia./type of well casing	2" Sch 40 PVC
5-	Type/slot size of screen	2" stainless steel 0.010" slot
6-	Type screen filter	#5 quartz sand filter pack
	a) Quantity used	~2 50-lb bags
6.5-	Fine sand seal (3-6" above filter pack)	#8 quartz sand
7-	Type of seal	1/4" coated bentonite pellets
	a) Quantity used	~1/4 of 5-gal bucket
8-	Grout	
	a) Grout mix used	Portland cement/bentonite
	b) Method of placement	Tremie pipe
	c) Vol. of well casing grout	
	Development method	3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser
	Development time	1:25
	Estimated purge volume	~110 gal
	Comments	

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-525	SHEET 1	OF 1

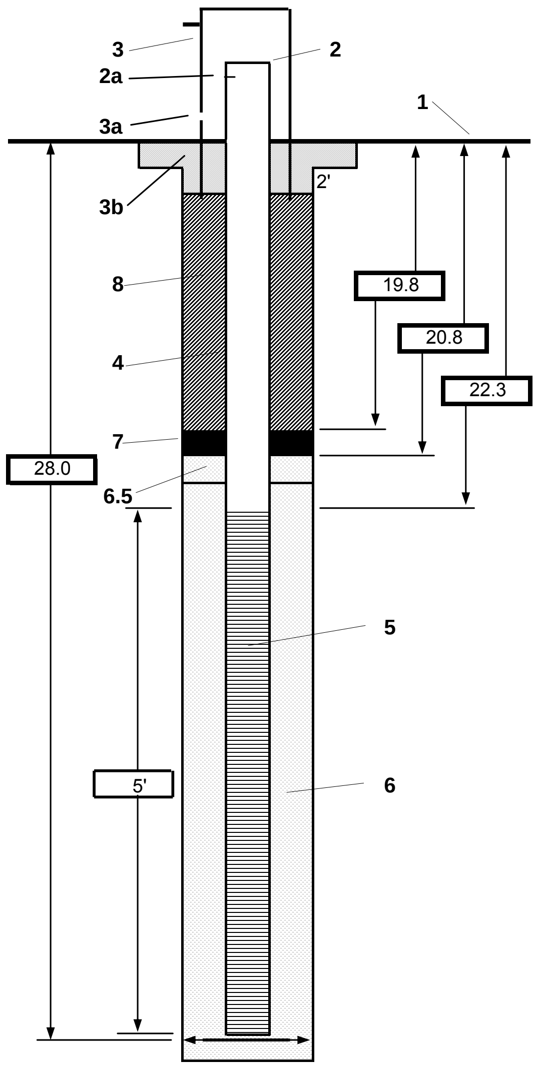
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/2/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.41 ft bgs START : 15:00 END : 18:00 LOGGER : E. Molander



1- Ground elevation at well: 588.38

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 0:55

Estimated purge volume: ~85 gal

Comments:

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-526 SHEET 1 OF 1

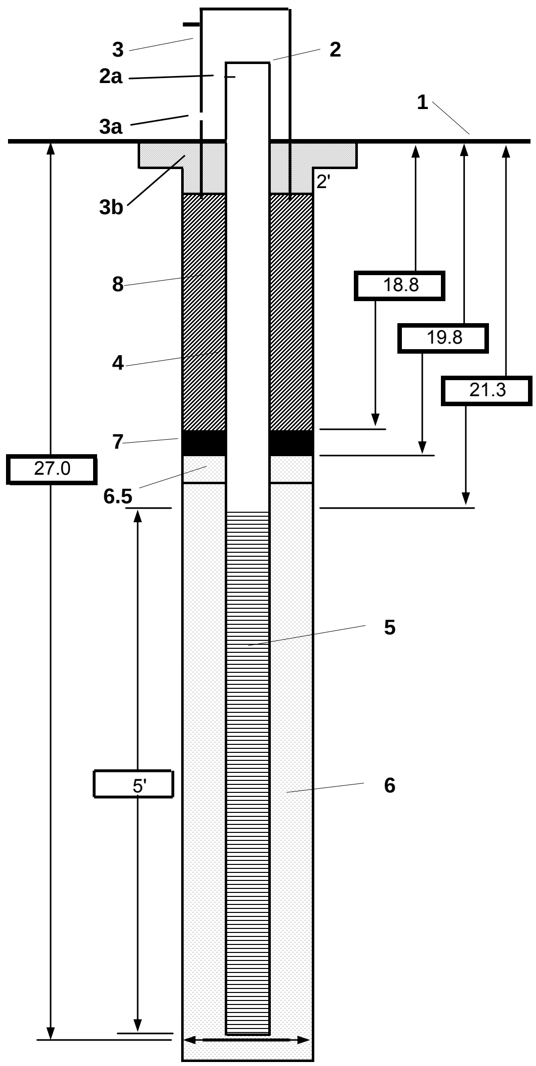
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.45 ft bgs START : 8:30 END: 11:45 LOGGER : E. Molander



1- Ground elevation at well 588.39

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:30

Estimated purge volume ~180 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-527**	SHEET 1	OF 1

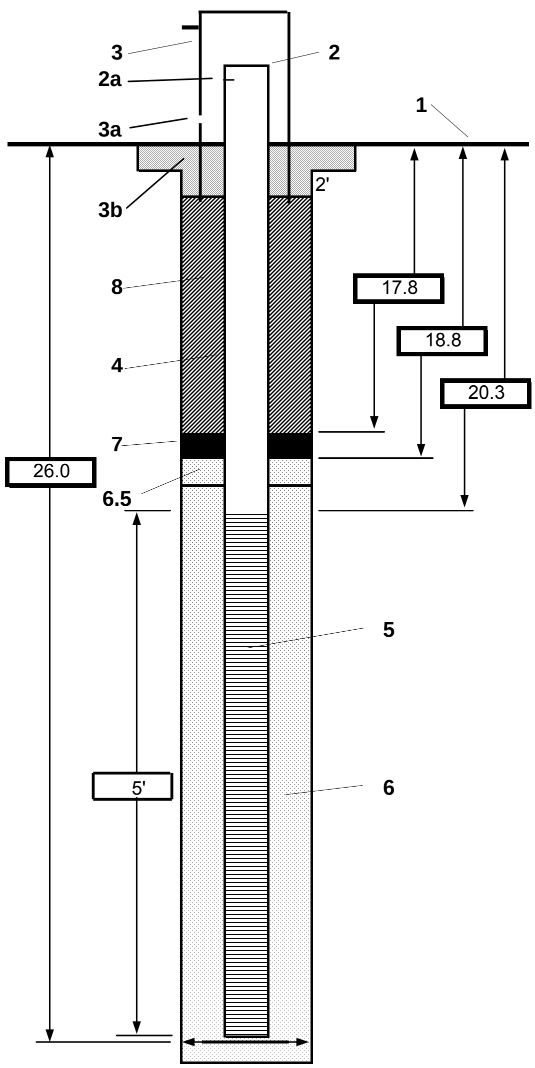
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : START : 13:45 END: 14:45 LOGGER : E. Molander



1- Ground elevation at well 588.40

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached
to 1" SCH 40 PVC riser

Development time 1:55

Estimated purge volume ~230 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-528**	SHEET 1	OF 1

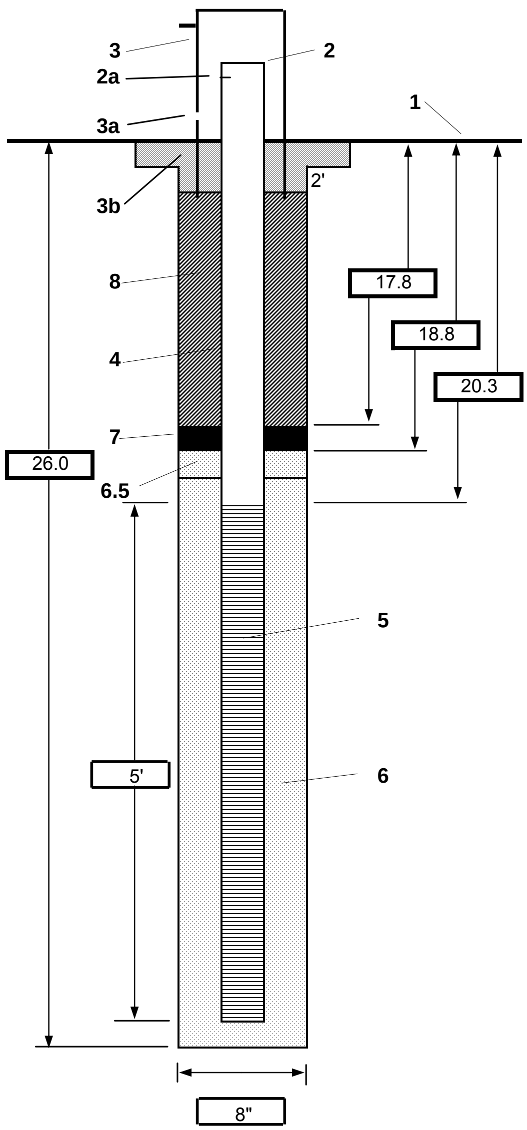
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 | LOCATION : Waukegan, IL | **1/4/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.47 ft bgs | START : 13:15 | END: 16:00 | LOGGER : E. Molander/VBR



1- Ground elevation at well 588.39

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter 10/20 sand filter pack
a) Quantity used ~1.5 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Gravity
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:25

Estimated purge volume ~170 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-529	SHEET 1	OF 1

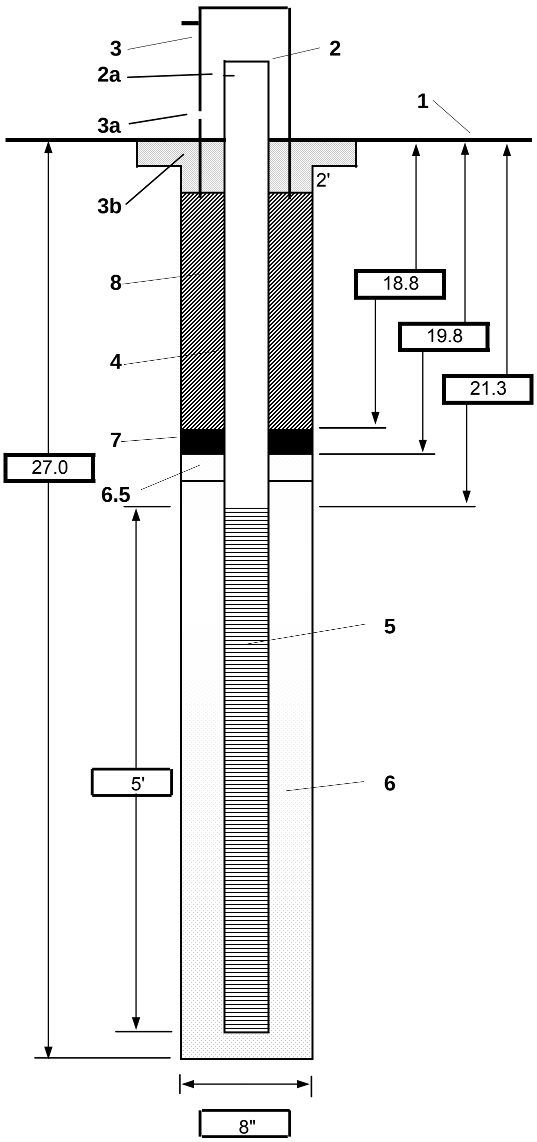
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/3/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.42 ft bgs START : 8:00 END: 9:20 LOGGER : E. Molander/VBR



1- Ground elevation at well: 588.43

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached
to 1" SCH 40 PVC riser

Development time: 1:20

Estimated purge volume: ~160 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-530** SHEET 1 OF 1

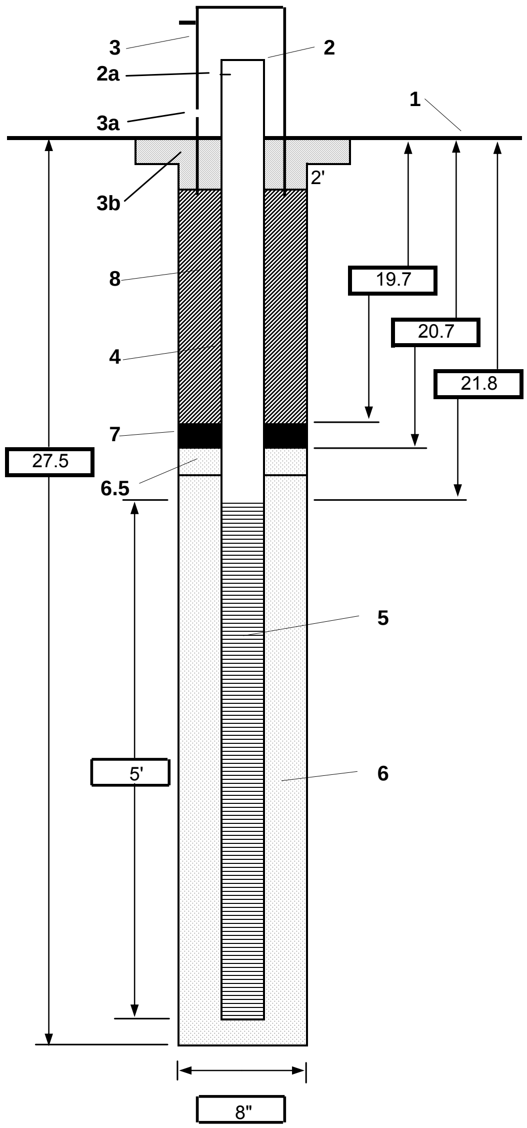
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/8/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.51 ft bgs START : 9:35 END: 11:30 LOGGER : VBR



1- Ground elevation at well 588.40

2- Top of casing elevation

a) vent hole? None

3- Wellhead protection cover type Flush mount

a) weep hole? None

b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel

0.010" slot

6- Type screen filter #5 quartz sand filter pack

a) Quantity used ~1.75 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets

a) Quantity used ~1/4 5-gal bucket

8- Grout

a) Grout mix used Portland cement/bentonite

b) Method of placement Tremie pipe

c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 0:45

Estimated purge volume ~90 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-531** SHEET 1 OF 1

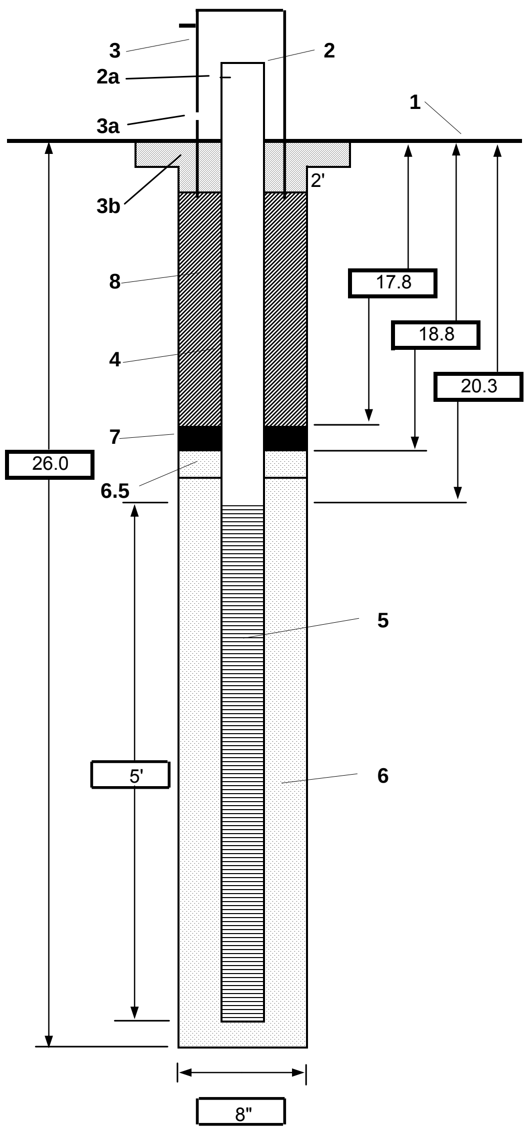
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/9/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.52 ft bgs START : 13:45 END: 15:00 LOGGER : VBR



1- Ground elevation at well: 588.37

2- Top of casing elevation:

a) vent hole? None

3- Wellhead protection cover type: Flush mount

a) weep hole? None

b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used: ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie pipe

c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:25

Estimated purge volume: ~170 gal

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-532	SHEET 1	OF 1

CH2MHILL

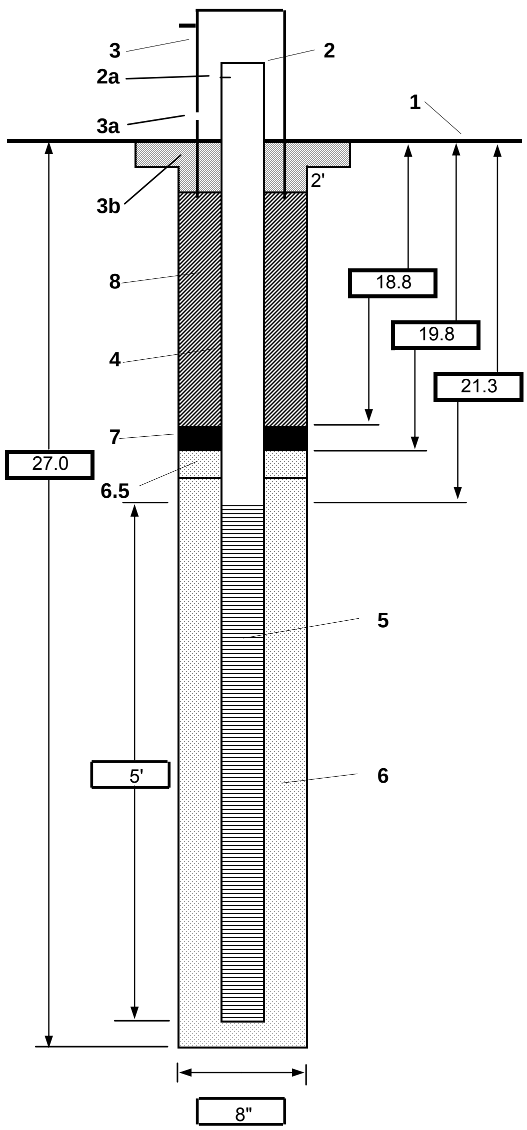
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/15/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.54 ft bgs START : 11:05 END: 12:10 LOGGER : VBR



1- Ground elevation at well: 588.32

2- Top of casing elevation:
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached
to 1" SCH 40 PVC riser

Development time: 1:25

Estimated purge volume: ~170 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	IW-533	SHEET 1	OF 1

CH2MHILL

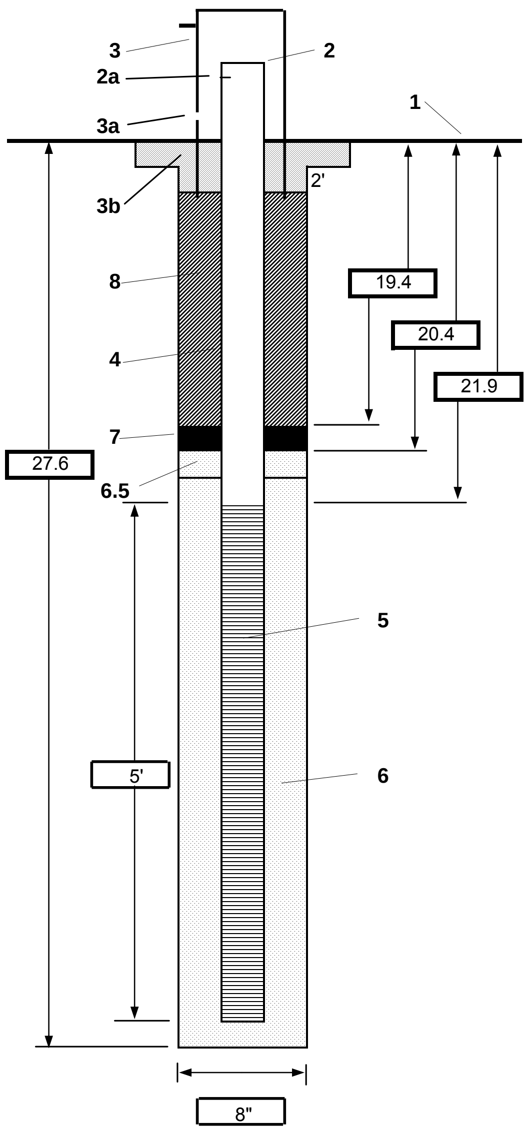
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/12/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.55 ft bgs START : 9:05 END: 10:40 LOGGER : VBR



1- Ground elevation at well: 588.39

2- Top of casing elevation:
   a) vent hole? None

3- Wellhead protection cover type: Flush mount
   a) weep hole? None
   b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
   0.010" slot

6- Type screen filter: #5 quartz sand filter pack
   a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
   a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
   a) Grout mix used: Portland cement/bentonite
   b) Method of placement: Tremie pipe
   c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:35

Estimated purge volume: ~190 gal

Comments:

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-534 SHEET 1 OF 1

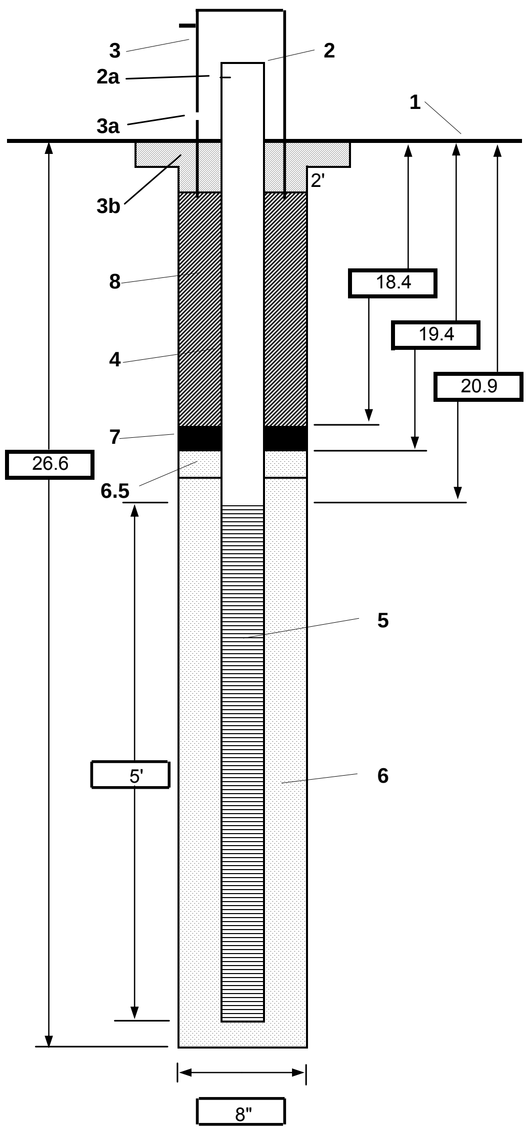
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/11/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.57 ft bgs START : 13:55 END: 16:30 LOGGER : VBR



1- Ground elevation at well 588.41

2- Top of casing elevation

a) vent hole? None

3- Wellhead protection cover type Flush mount

a) weep hole? None

b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack

a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets

a) Quantity used ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used Portland cement/bentonite

b) Method of placement Tremie pipe

c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 2:20

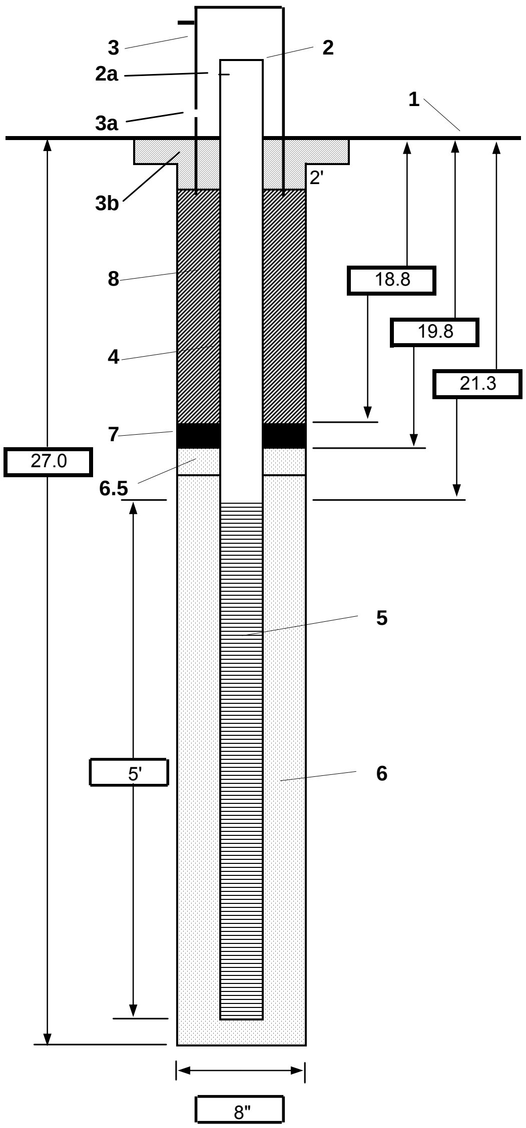
Estimated purge volume ~280 gal

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**IW-535**	SHEET 1	OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/11/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.72 ft bgs START : 10:35 END: 13:25 LOGGER : VBR



1- Ground elevation at well 588.43

2- Top of casing elevation
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used ~2 50-lb bags
6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand
7- Type of seal 1/4" coated bentonite pellets
a) Quantity used ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie pipe
c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1:35

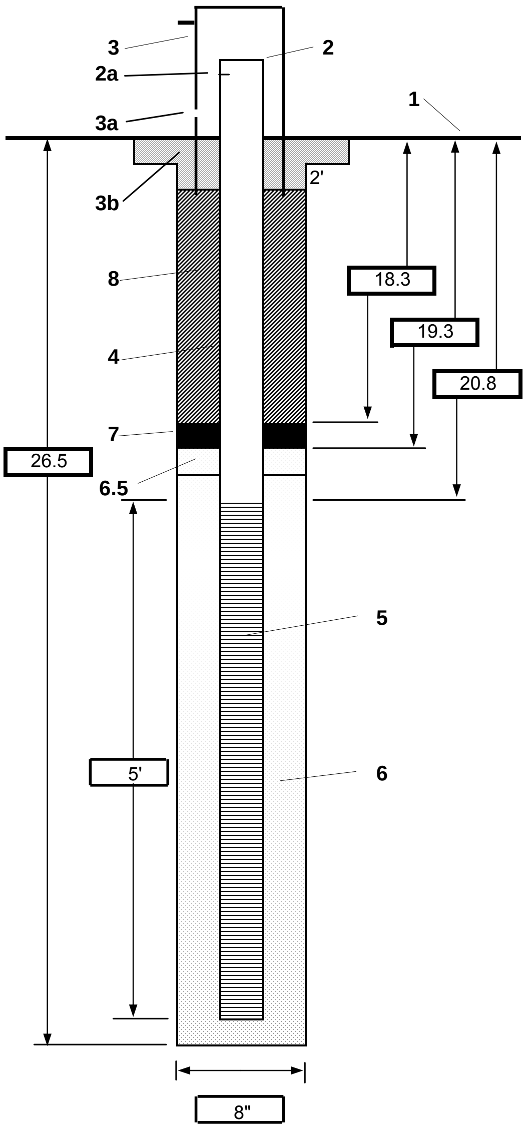
Estimated purge volume ~190 gal

Comments

PROJECT NUMBER	WELL NUMBER
348136.TT.01	**IW-536** SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/10/2007**
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT
WATER LEVELS : 5.54 ft bgs START : 14:45 END: 15:45 LOGGER : VBR



1- Ground elevation at well: 588.41

2- Top of casing elevation:
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions: 12" diameter

4- Dia./type of well casing: 2" Sch 40 PVC

5- Type/slot size of screen: 2" stainless steel
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used: ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used: ~1/4 of 5-gal bucket

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie pipe
c) Vol. of well casing grout:

Development method: 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time: 1:55

Estimated purge volume: ~230 gal

Comments:

PROJECT NUMBER	WELL NUMBER
348136.TT.01	IW-537 SHEET 1 OF 1

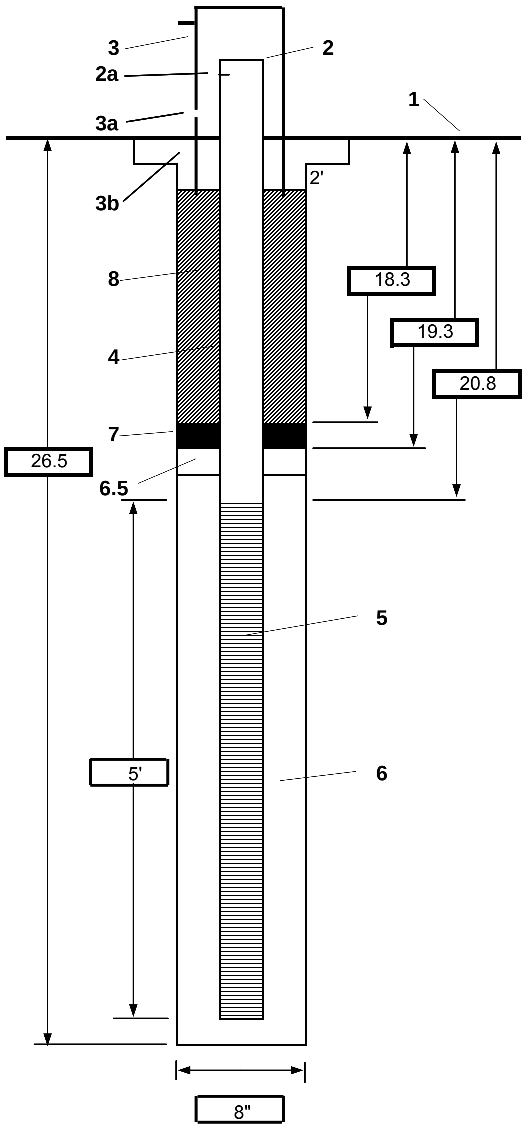
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/10/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA / 6610DT

WATER LEVELS : 5.55 ft bgs START : 10:05 END: 11:05 LOGGER : VBR



1- Ground elevation at well 588.40

2- Top of casing elevation

a) vent hole? None

3- Wellhead protection cover type Flush mount

a) weep hole? None

b) concrete pad dimensions 12" diameter

4- Dia./type of well casing 2" Sch 40 PVC

5- Type/slot size of screen 2" stainless steel

0.010" slot

6- Type screen filter #5 quartz sand filter pack

a) Quantity used ~2 50-lb bags

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets

a) Quantity used ~1/4 of 5-gal bucket

8- Grout

a) Grout mix used Portland cement/bentonite

b) Method of placement Tremie pipe

c) Vol. of well casing grout

Development method 3-phase Mini-Monsoon Pump attached to 1" SCH 40 PVC riser

Development time 1;10

Estimated purge volume ~140 gal

Comments

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-518D	SHEET 1	OF 1

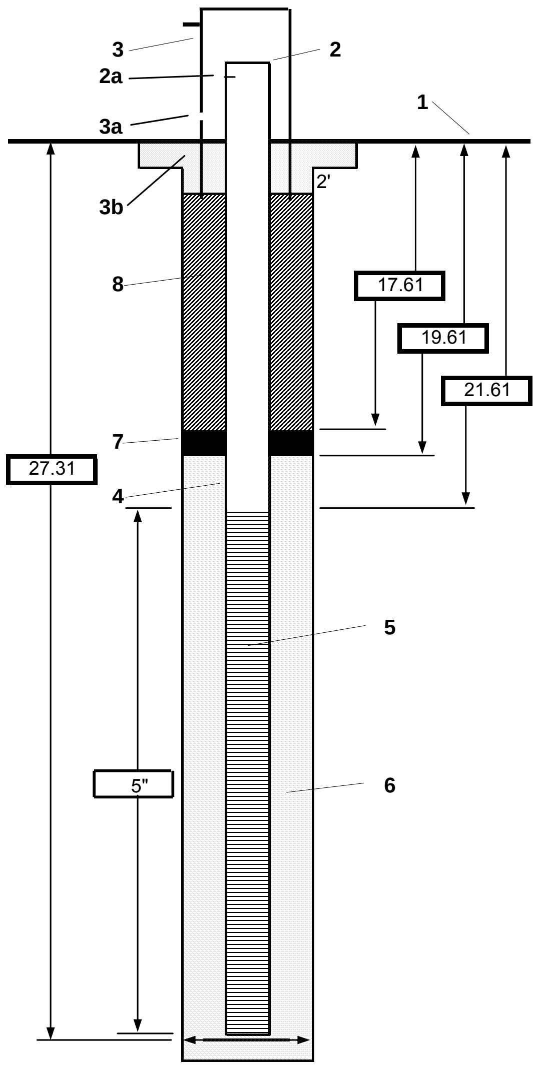
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/30/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.88 ft bgs START : END: LOGGER : EM/VBR



1- Ground elevation at well: 588.34 ft amsl

2- Top of casing elevation: 588.00 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER		
348138.TT.01	MW-518S	SHEET 1	OF 1

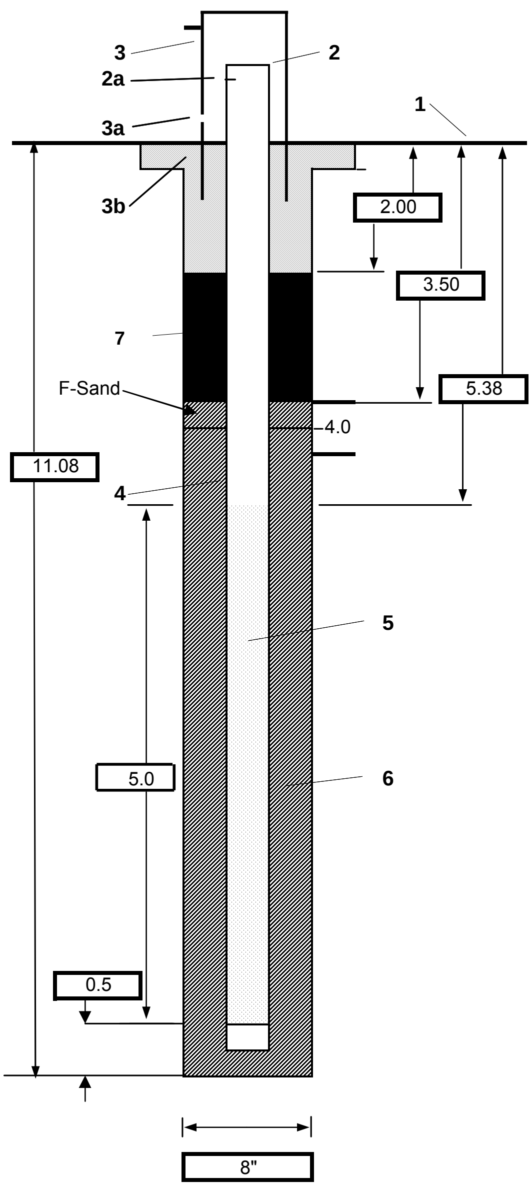
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 5.88 ft bgs START : 1000 END: 1055 LOGGER : VBR



1- Ground elevation at well: 588.33 ft amsl

2- Top of casing elevation: 587.95 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PVC/0.010" slot

6- Type screen filter: Quartz sand pack #5
a) Quantity used:

7- Type of seal: Bentonite chips - hydrated
a) Quantity used:

8- Grout
a) Grout mix used: N/A
b) Method of placement:
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments: 1/2' fine sand (#8) placed on top of #5 filter pack

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-519D	SHEET 1	OF 1

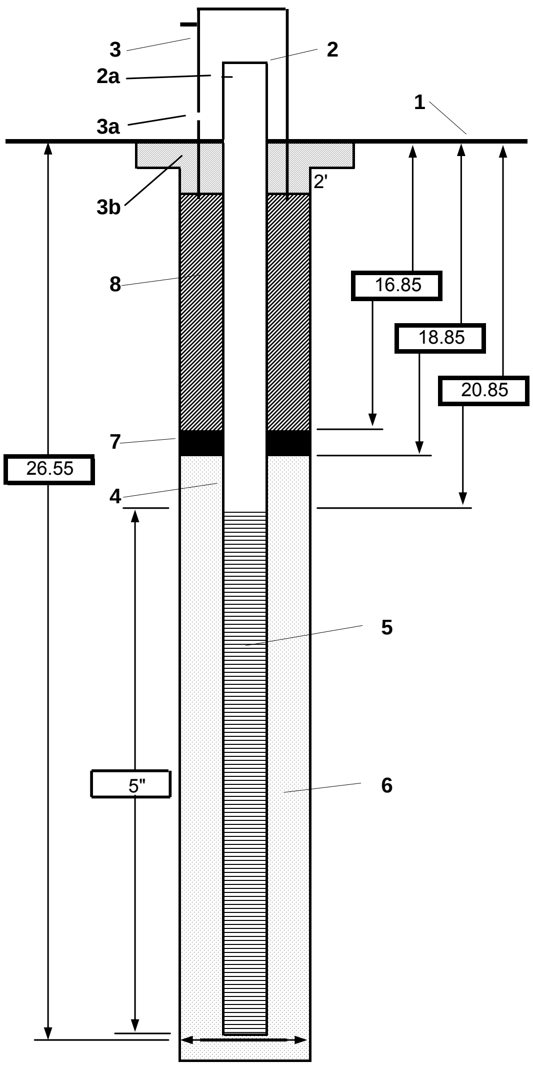
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/13/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.71 ft bgs START : END: LOGGER : K.Davis



1- Ground elevation at well: 588.16 ft amsl

2- Top of casing elevation: 587.84 ft amsl
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-519S	SHEET 1 OF 1

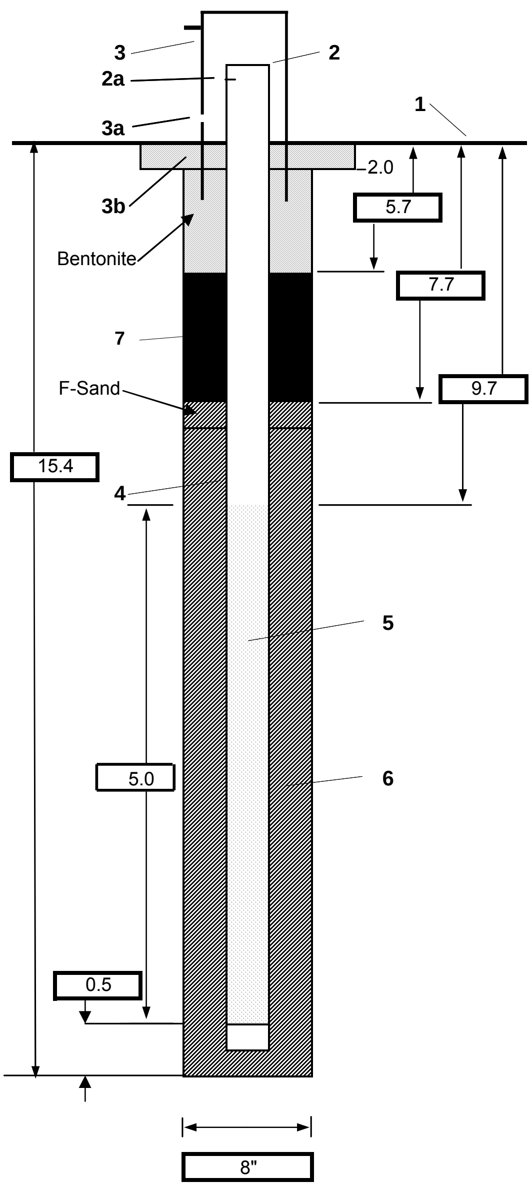
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT

WATER LEVELS : 5.71 ft bgs START : 1030 END: 1230 LOGGER : EM/VBR



1- Ground elevation at well	588.17 ft amsl
2- Top of casing elevation	587.82 ft amsl
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	
4- Dia./type of well casing	2" PVC
5- Type/slot size of screen	2" PVC/0.010" slot
6- Type screen filter	Quartz sand pack #5
a) Quantity used	2.5 Bags
7- Type of seal	Bentonite pellets
a) Quantity used	~ 1/2 of a 5-gal bucket
8- Grout	
a) Grout mix used	Bentonite
b) Method of placement	Gravity
c) Vol. of well casing grout	2.5 Bags Enviroplug
Development method	
Development time	
Estimated purge volume	

Comments 1' fine sand (#8) placed on top of #5 filter pack; 2' bentonite pellets above fine sand; 2.5 bags bentonite - hydrated

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-520D	SHEET 1	OF 1

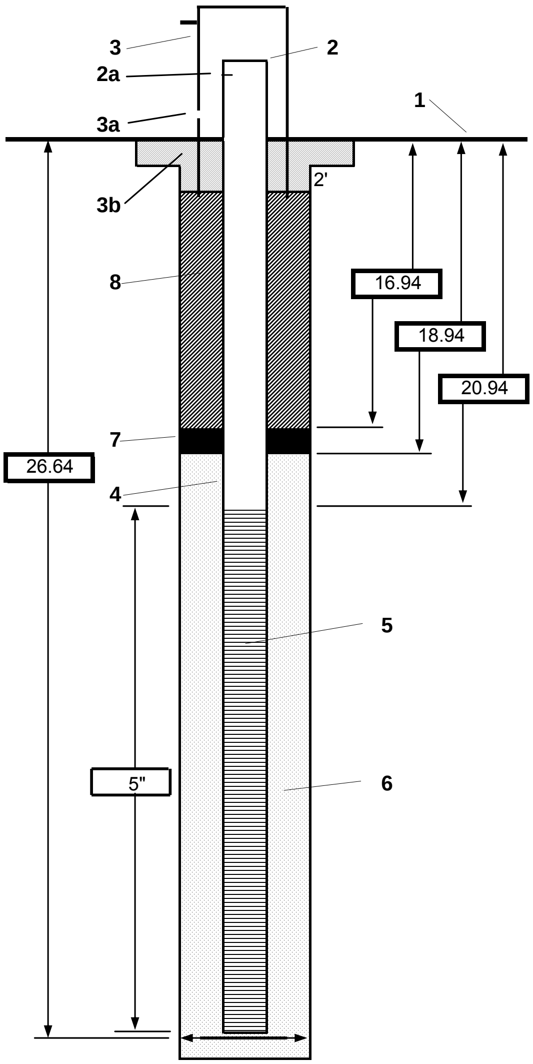
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/30/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.81 ft bgs START : END: LOGGER : EM



1- Ground elevation at well 588.13 ft amsl

2- Top of casing elevation 587.81 ft amsl
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions

4- Dia./type of well casing 2" PVC

5- Type/slot size of screen 2" PCV
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie
c) Vol. of well casing grout

Development method

Development time

Estimated purge volume

Comments

PROJECT NUMBER	WELL NUMBER		
348138.TT.01	MW-520S	SHEET 1	OF 1

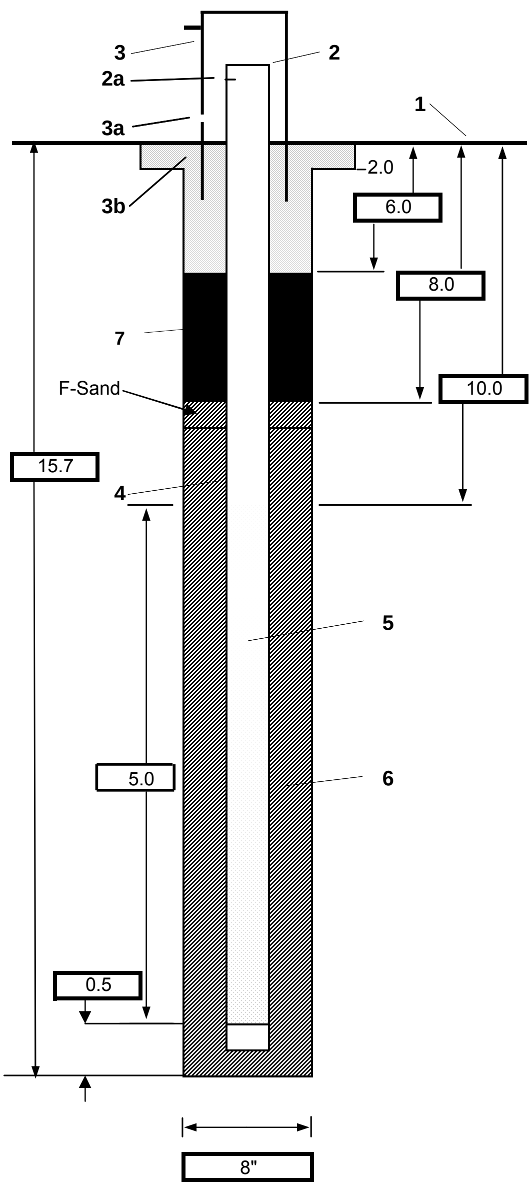
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 5.45 ft bgs START : 0930 END: 1015 LOGGER : VBR



1- Ground elevation at well: 588.10 ft amsl

2- Top of casing elevation: 587.67 ft amsl
a) vent hole? None

3- Wellhead protection cover type: Flush mount
a) weep hole? None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PVC/0.010" slot

6- Type screen filter: Quartz sand pack #5 (with 1' fine sand)
a) Quantity used: ~ 2.2 Bags

7- Type of seal: Bentonite 1/4" tablets
a) Quantity used: 1/2 of a 5-gal bucket

8- Grout
a) Grout mix used: Only bentonite chips
b) Method of placement: Gravity
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments: 1' fine sand (#8) placed above filter pack; no Portland cement used in grout; bentonite chips hydrated

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-521D**	SHEET 1	OF 1

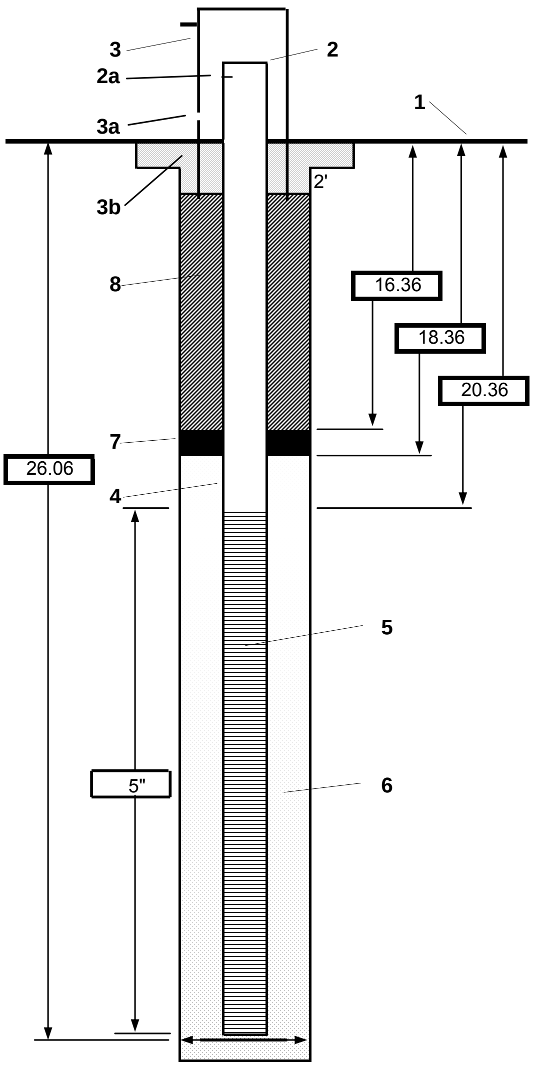
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/25/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 6.58 ft bgs START : END: LOGGER : EM



1- Ground elevation at well: 588.33 ft amsl

2- Top of casing elevation: 588.08 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-521S	SHEET 1 OF 1

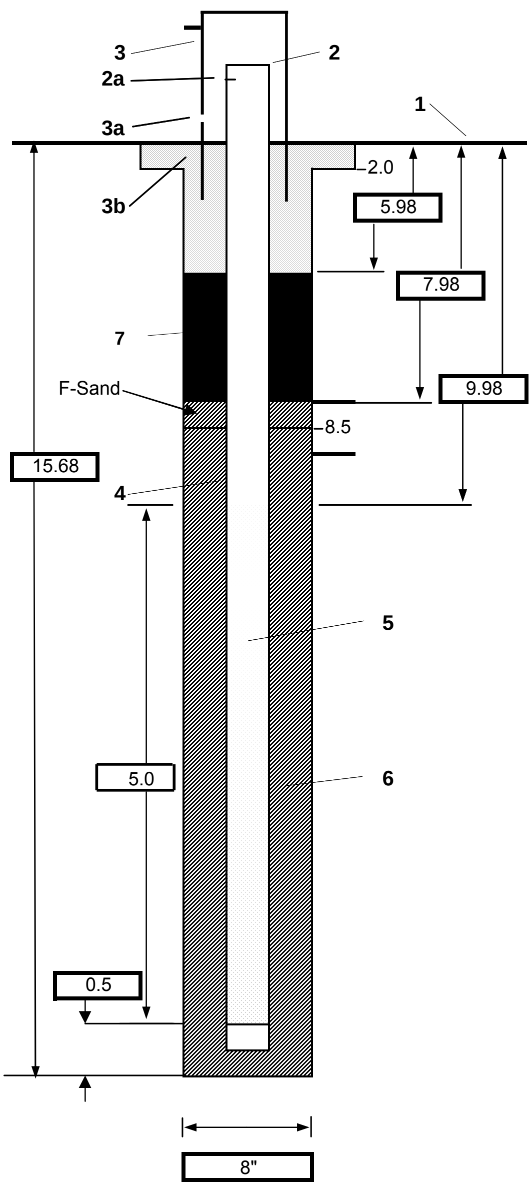
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 5.57 ft bgs START : 1305 END: 1325 LOGGER : VBR



1- Ground elevation at well	588.33 ft amsl
2- Top of casing elevation	587.90 ft amsl
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	
4- Dia./type of well casing	2" PVC
5- Type/slot size of screen	2" PVC/0.010" slot
6- Type screen filter	Quartz sand pack #5
a) Quantity used	~ 2.2 Bags
7- Type of seal	Bentonite 1/4" tablets
a) Quantity used	1/2 of a 5-gal bucket (5-gal bucket = 50 lb)
8- Grout	
a) Grout mix used	Only bentonite chips
b) Method of placement	Gravity
c) Vol. of well casing grout	
Development method	
Development time	
Estimated purge volume	

Comments 1' fine sand (#8) placed above filter pack; bentonite chips hydrated

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-522D	SHEET 1	OF 1

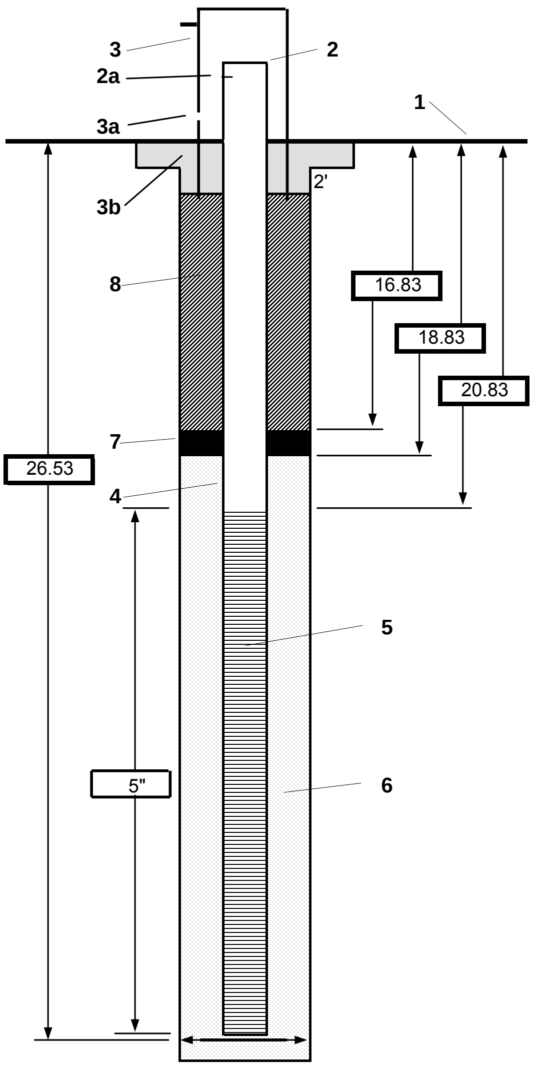
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/25/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.93 ft bgs START : END: LOGGER : EM



1- Ground elevation at well 588.33 ft amsl

2- Top of casing elevation 588.06 ft amsl
  a) vent hole? None

3- Wellhead protection cover type Flush mount
  a) weep hole? None
  b) concrete pad dimensions

4- Dia./type of well casing 2" PVC

5- Type/slot size of screen 2" stainless steel
  0.010" slot

6- Type screen filter #5 quartz sand filter pack
  a) Quantity used

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
  a) Quantity used

8- Grout
  a) Grout mix used Portland cement/bentonite
  b) Method of placement Tremie
  c) Vol. of well casing grout

Development method

Development time

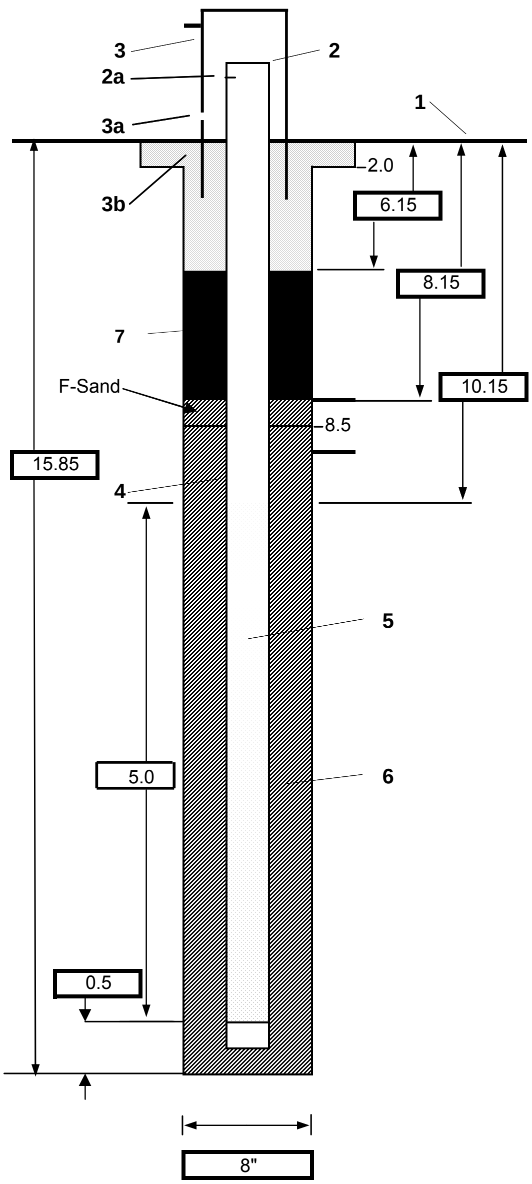
Estimated purge volume

Comments

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-522S	SHEET 1 OF 1

WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL
DRILLING CONTRACTOR : IPS
DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted
WATER LEVELS : 5.71 ft bgs START : 1440 END: 1500 LOGGER : VBR



1- Ground elevation at well	588.35 ft amsl
2- Top of casing elevation	588.04 ft amsl
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	
4- Dia./type of well casing	2" PVC
5- Type/slot size of screen	2" PVC/0.010" slot
6- Type screen filter	Quartz sand pack #5
a) Quantity used	~ 2.2 Bags
7- Type of seal	Bentonite 1/4" tablets
a) Quantity used	1/2 of a 5-gal bucket
8- Grout	
a) Grout mix used	Only bentonite chips
b) Method of placement	Gravity
c) Vol. of well casing grout	
Development method	
Development time	
Estimated purge volume	

Comments 1' fine sand (#8) placed above filter pack; bentonite chips hydrated

NOTE: Well reset between 1510 and 1610

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-523D**	SHEET 1	OF 1

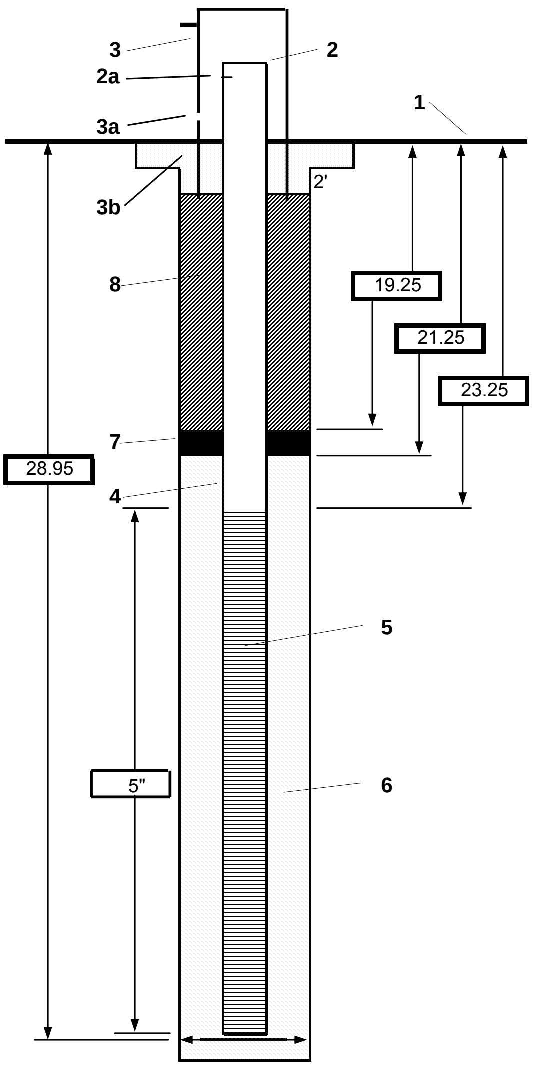
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/20/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.45 ft bgs START : END: LOGGER : EM



1- Ground elevation at well: 585.55 ft amsl

2- Top of casing elevation: 588.14 ft amsl
   a) vent hole?: None

3- Wellhead protection cover type: Flush mount
   a) weep hole?: None
   b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
   0.010" slot

6- Type screen filter: #5 quartz sand filter pack
   a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
   a) Quantity used:

8- Grout
   a) Grout mix used: Portland cement/bentonite
   b) Method of placement: Tremie
   c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
348138.TT.01	MW-523S	SHEET 1	OF 1

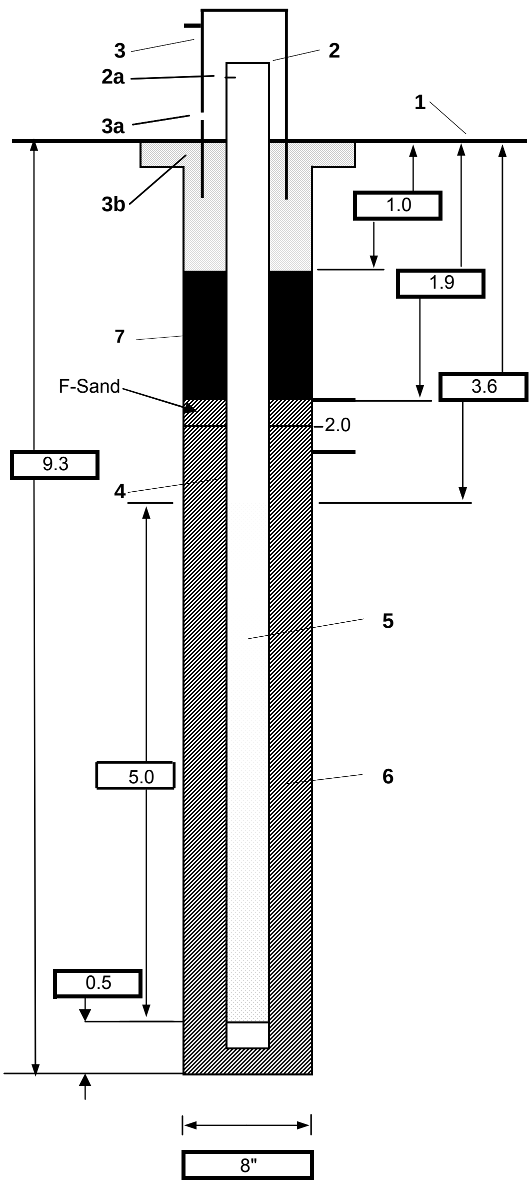
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 6.53 ft bgs START : 1020 END: 1045 LOGGER : VBR



1- Ground elevation at well	585.55 ft amsl
2- Top of casing elevation	588.18 ft amsl
a) vent hole?	None
3- Wellhead protection cover type	Stick up
a) weep hole?	None
b) concrete pad dimensions	
4- Dia./type of well casing	2" PVC
5- Type/slot size of screen	2" PVC/0.010" slot
6- Type screen filter	Quartz sand pack #5
a) Quantity used	~ 2 Bags
7- Type of seal	Bentonite 1/4" tablets
a) Quantity used	1/8 of a 5-gal bucket
8- Grout	
a) Grout mix used	Only bentonite chips
b) Method of placement	Gravity
c) Vol. of well casing grout	
Development method	
Development time	
Estimated purge volume	

Comments ~2" Fine sand (#8) placed on top of filter pack

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-524S	SHEET 1 OF 1

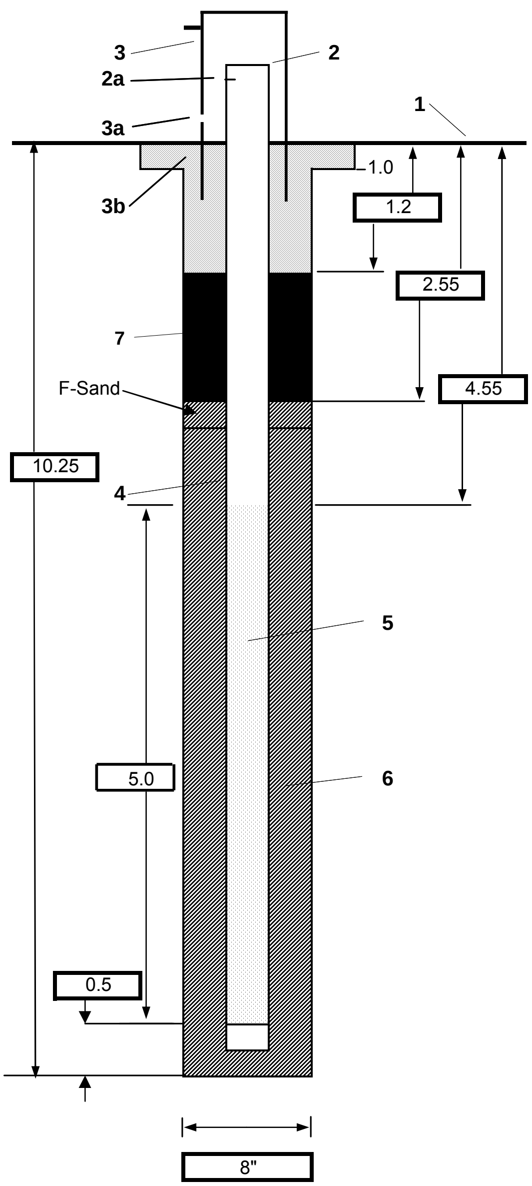
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 6.14 ft bgs START : 1325 END: 1340 LOGGER : VBR



1-	Ground elevation at well	585.43 ft amsl
2-	Top of casing elevation	587.99 ft amsl
	a) vent hole?	None
3-	Wellhead protection cover type	Stick up
	a) weep hole?	None
	b) concrete pad dimensions	
4-	Dia./type of well casing	2" PVC
5-	Type/slot size of screen	2" PVC/0.010" slot
6-	Type screen filter	Quartz sand pack #5
	a) Quantity used	~ 2 Bags
7-	Type of seal	Bentonite 1/4" tablets
	a) Quantity used	1/8 of a 5-gal bucket
8-	Grout	
	a) Grout mix used	Only bentonite chips
	b) Method of placement	Gravity
	c) Vol. of well casing grout	
	Development method	
	Development time	
	Estimated purge volume	
	Comments	~2" Fine sand (#8) placed on top of filter pack

PROJECT NUMBER	WELL NUMBER
348136.TT.01	MW-525D SHEET 1 OF 1

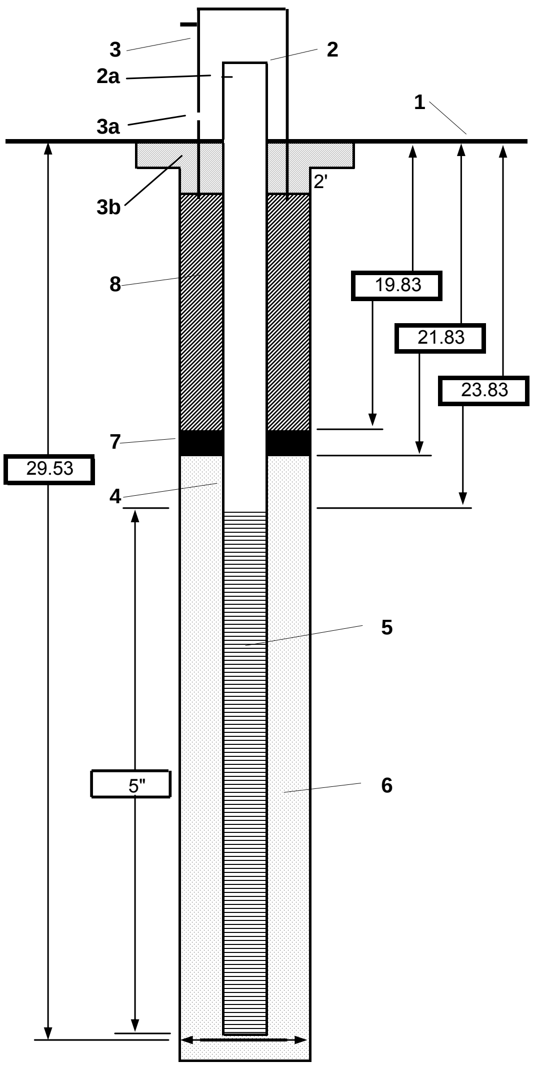
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/12/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 6.58 ft bgs START : END: LOGGER : K.Davis, I. Mueller



1- Ground elevation at well: 585.62 ft amsl

2- Top of casing elevation: 588.18 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Stick-up
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-525S	SHEET 1 OF 1

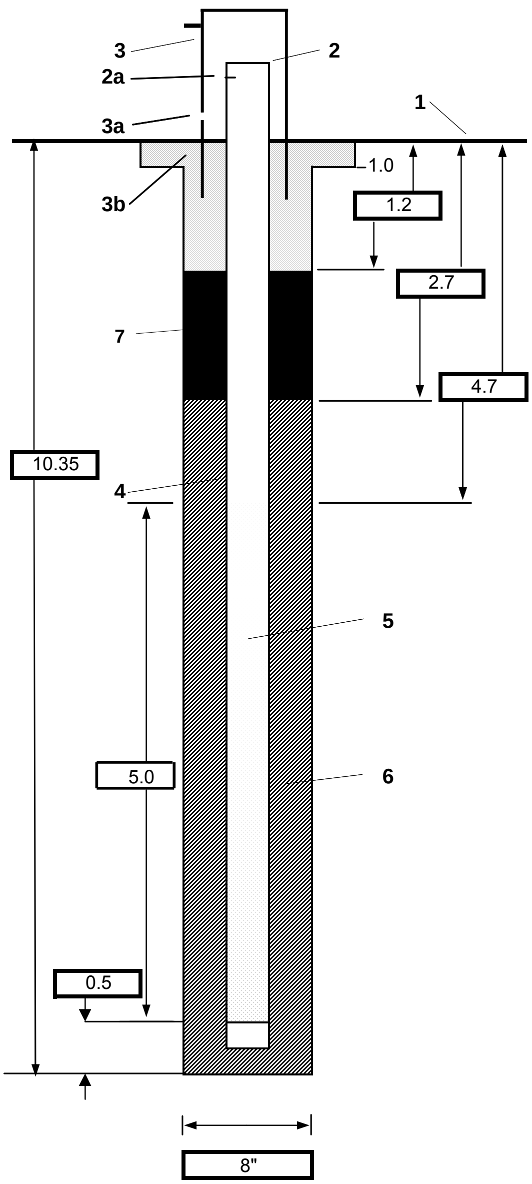
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 5.74 ft bgs START : 1420 END : 1440 LOGGER : VBR



1- Ground elevation at well: 585.75 ft amsl

2- Top of casing elevation: 588.32 ft amsl
   a) vent hole? None

3- Wellhead protection cover type: Stick up
   a) weep hole? None
   b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PVC/0.010" slot

6- Type screen filter: Quartz sand pack HS
   a) Quantity used: ~ 2 Bags

7- Type of seal: Bentonite 1/4" tablets
   a) Quantity used: 1/2 of a 5-gal bucket

8- Grout
   a) Grout mix used: Only bentonite chips
   b) Method of placement: Gravity
   c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments: ~ 2" Fine sand (#8) placed on top of filter pack

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-526D	SHEET 1	OF 1

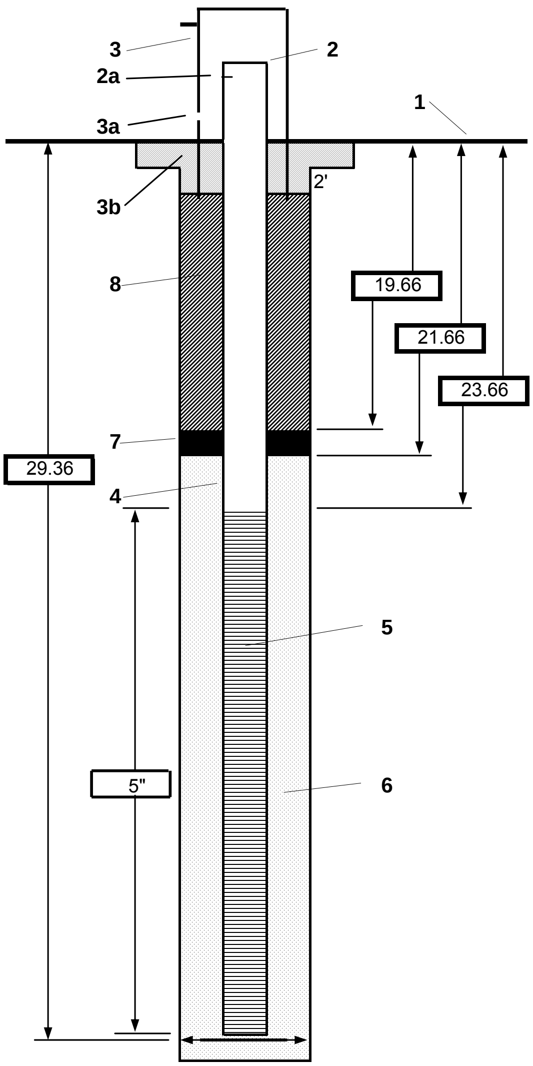
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **1/26/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 6.17 ft bgs START : END: LOGGER :



1- Ground elevation at well: 585.13 ft amsl

2- Top of casing elevation: 587.90 ft amsl

a) vent hole?: None

3- Wellhead protection cover type: Flush mount

a) weep hole?: None

b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV

0.010" slot

6- Type screen filter: #5 quartz sand filter pack

a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets

a) Quantity used:

8- Grout

a) Grout mix used: Portland cement/bentonite

b) Method of placement: Tremie

c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
348138.TT.01	MW-526S	SHEET 1	OF 1

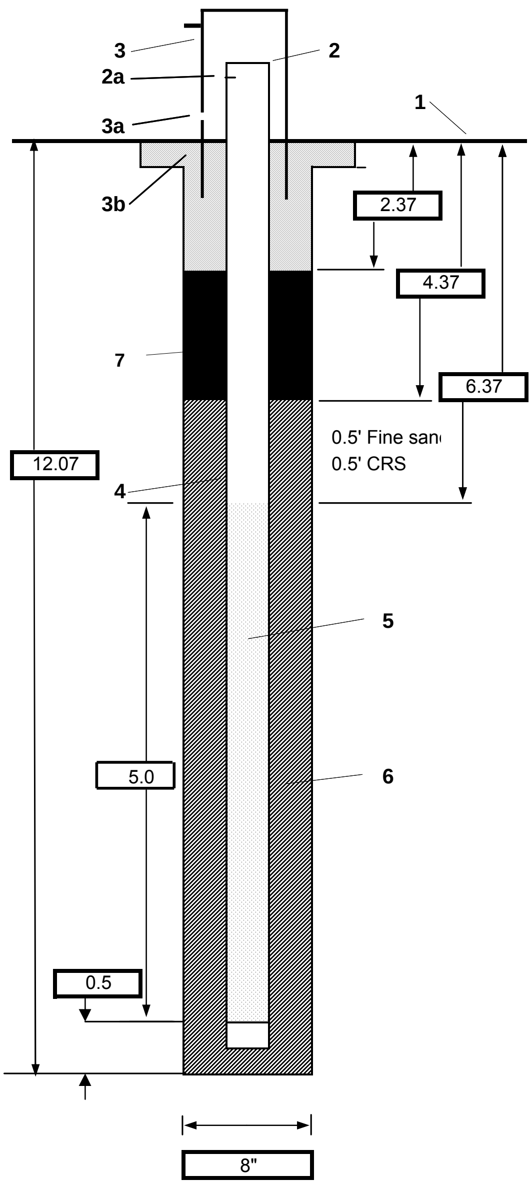
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL **1/31/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 6.17 ft bgs START : 1000 END : 1130 LOGGER: HJR



1- Ground elevation at well: 585.14 ft amsl

2- Top of casing elevation: 587.89 ft amsl
- a) vent hole? None

3- Wellhead protection cover type: Flush mount
- a) weep hole? None
- b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PVC/0.010" slot

6- Type screen filter: Quartz filter pack #5
- a) Quantity used:

7- Type of seal: Bentonite 1/4" tablets - hydrated
- a) Quantity used: 1.5 bags

8- Grout
- a) Grout mix used: Bentonite chips
- b) Method of placement: Gravity
- c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments 6" fine sand, 6" CRS sand on top of filter pack, no cement in grout, bentonite tablets - hydrated

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-527D**	SHEET 1	OF 1

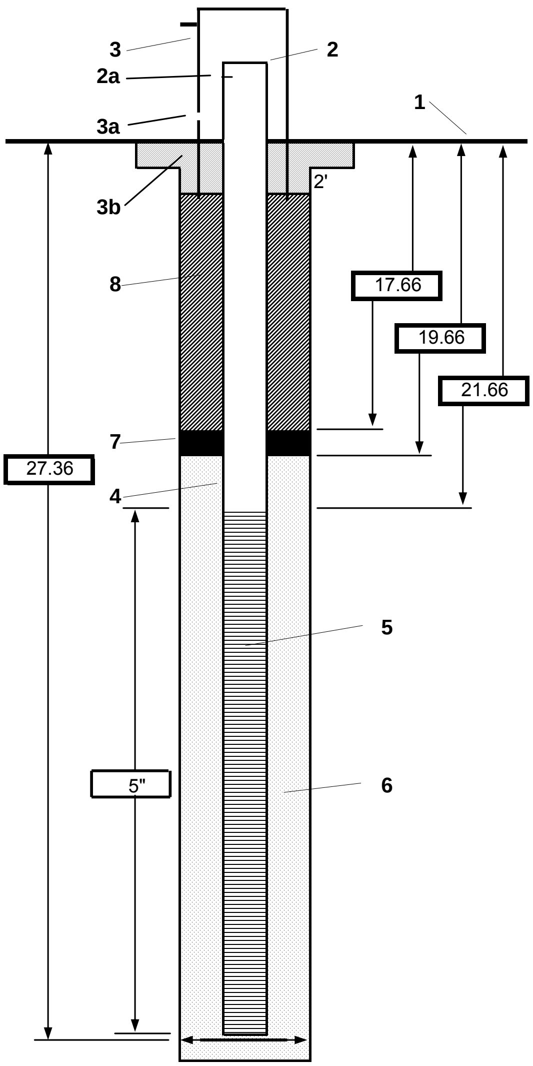
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/19/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 3.14 ft bgs START : END: LOGGER : HJR



1- Ground elevation at well: 584.57 ft amsl

2- Top of casing elevation: 584.31 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

CH2MHILL

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-527S**	SHEET 1	OF 1

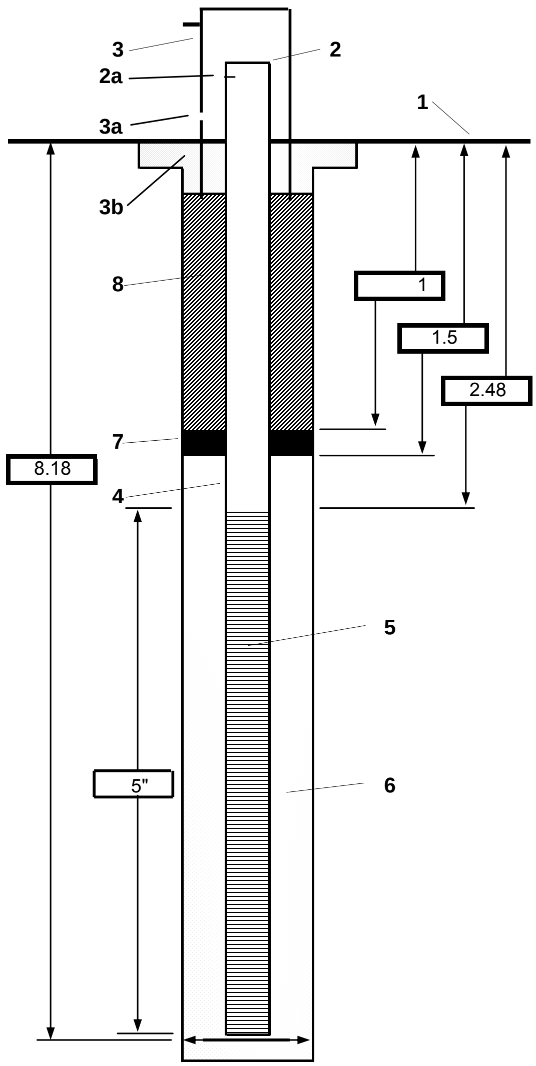
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/1/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 3.36 ft bgs START : END: LOGGER : HJR



1- Ground elevation at well: 584.49 ft amsl

2- Top of casing elevation: 584.29 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-528D**	SHEET 1	OF 1

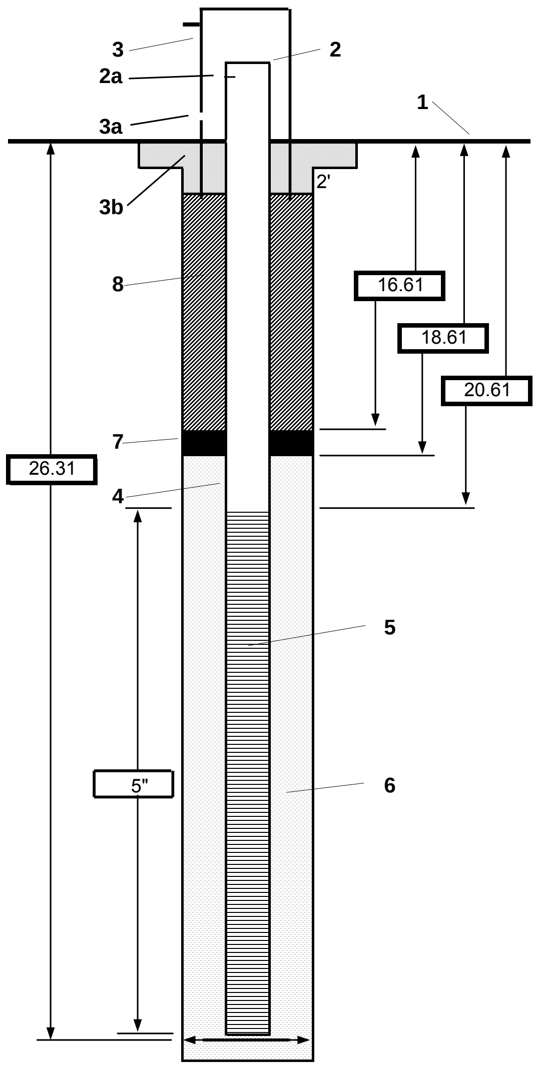
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/1/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.22 ft bgs START : END: LOGGER : HJR



1- Ground elevation at well 586.62 ft amsl

2- Top of casing elevation 586.40 ft amsl
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions

4- Dia./type of well casing 2" PVC

5- Type/slot size of screen 2" PCV
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie
c) Vol. of well casing grout

Development method

Development time

Estimated purge volume

Comments

CH2MHILL

PROJECT NUMBER	WELL NUMBER	
348138.TT.01	MW-528S	SHEET 1 OF 1

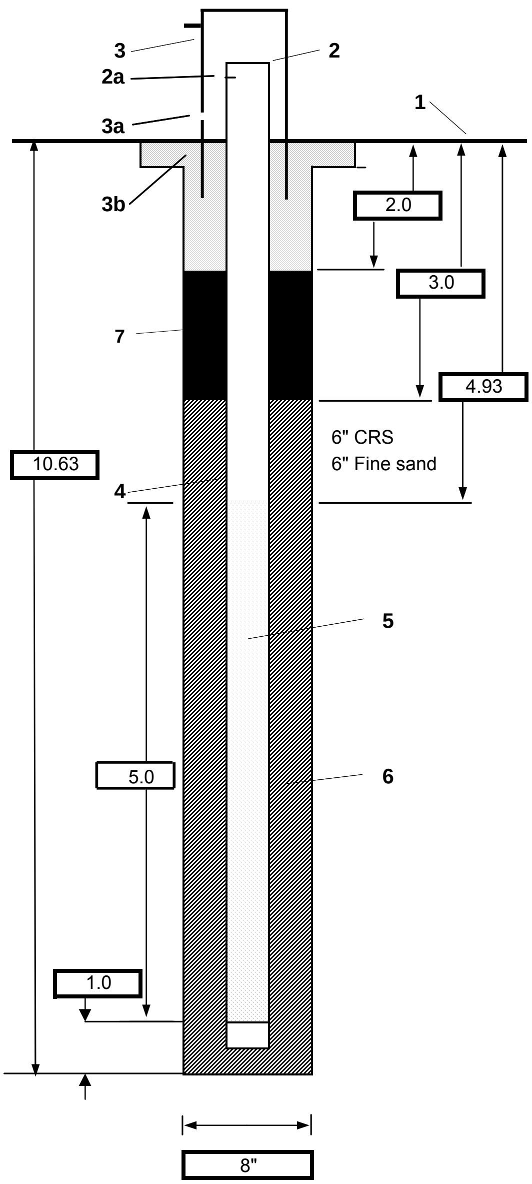
WELL COMPLETION DIAGRAM

PROJECT : Waukegan OMC Plant 2 LOCATION: Waukegan, IL

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA-Geoprobe 6610 DT - Truck mounted

WATER LEVELS : 5.23 ft bgs START : 1345 END : 1600 LOGGER : HJR



1- Ground elevation at well: 586.76 ft amsl

2- Top of casing elevation: 586.46 ft amsl
   a) vent hole? None

3- Wellhead protection cover type: Flush mount
   a) weep hole? None
   b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC/0.10" slot

5- Type/slot size of screen: 2" PVC/0.010" slot

6- Type screen filter: Quartz filter pack #5 with fine sand
   a) Quantity used:

7- Type of seal: Bentonite 1/4" tablets - hydrated
   a) Quantity used: 1.5 bags whole pkg

8- Grout
   a) Grout mix used: Bentonite chips
   b) Method of placement: Gravity
   c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments 6" fine sand, 6" CRS sand on top of filter pack, no cement in grout, bentonite tablets - hydrated

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-529D	SHEET 1	OF 1

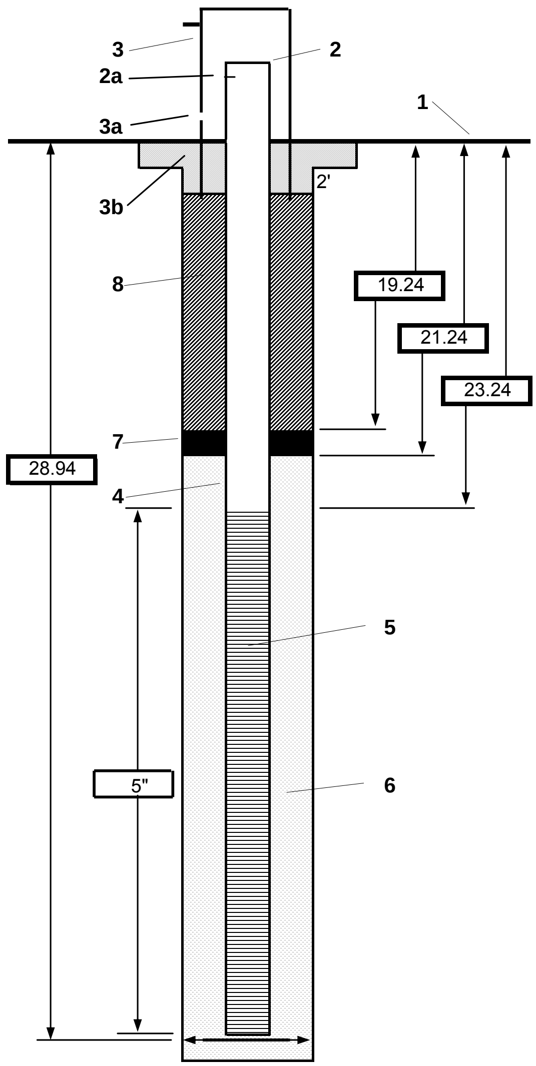
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/19/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.01 ft bgs START : END: LOGGER : HJR



1- Ground elevation at well 586.51 ft amsl

2- Top of casing elevation 586.16 ft amsl
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions

4- Dia./type of well casing 2" PVC

5- Type/slot size of screen 2" PCV
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie
c) Vol. of well casing grout

Development method

Development time

Estimated purge volume

Comments

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	**MW-529S**	SHEET 1	OF 1

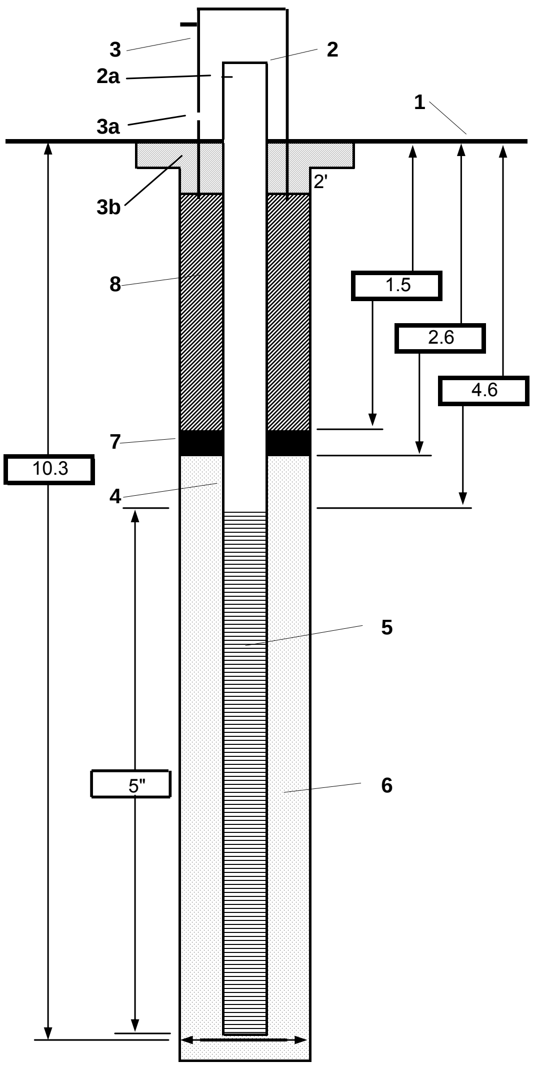
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/1/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 5.04 ft bgs START : END: LOGGER : HJR



1- Ground elevation at well: 586.46 ft amsl

2- Top of casing elevation: 586.06 ft amsl
a) vent hole?: None

3- Wellhead protection cover type: Flush mount
a) weep hole?: None
b) concrete pad dimensions:

4- Dia./type of well casing: 2" PVC

5- Type/slot size of screen: 2" PCV
0.010" slot

6- Type screen filter: #5 quartz sand filter pack
a) Quantity used:

6.5- Fine sand seal (3-6" above filter pack): #8 quartz sand

7- Type of seal: 1/4" coated bentonite pellets
a) Quantity used:

8- Grout
a) Grout mix used: Portland cement/bentonite
b) Method of placement: Tremie
c) Vol. of well casing grout:

Development method:

Development time:

Estimated purge volume:

Comments:

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-530D	SHEET 1	OF 1

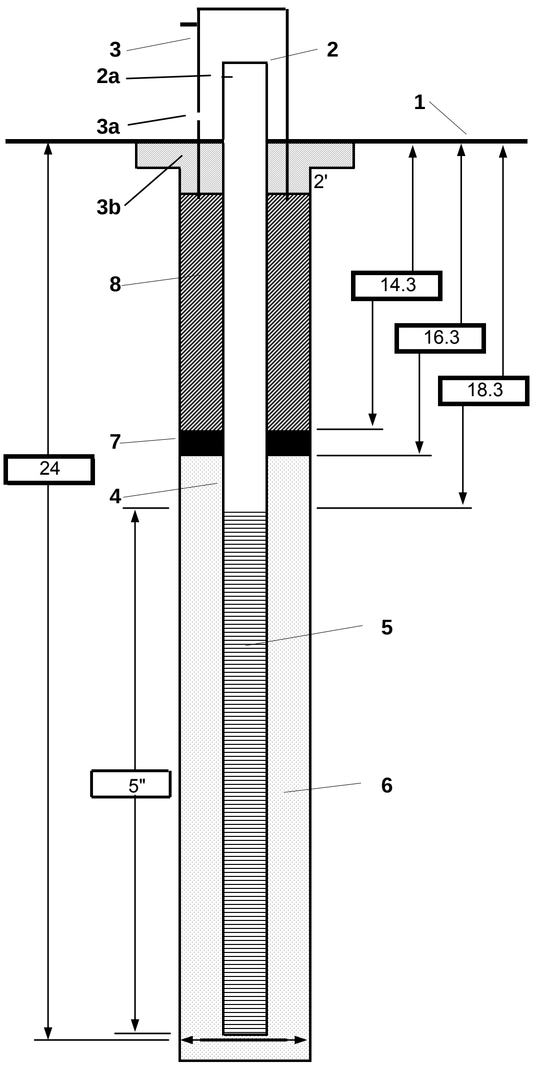
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **3/5/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 2.55 ft bgs START : END: LOGGER : I. Mueller



1- Ground elevation at well	
2- Top of casing elevation	
a) vent hole?	None
3- Wellhead protection cover type	Flush mount
a) weep hole?	None
b) concrete pad dimensions	
4- Dia./type of well casing	2" PVC
5- Type/slot size of screen	2" PCV
	0.010" slot
6- Type screen filter	#5 quartz sand filter pack
a) Quantity used	
6.5- Fine sand seal (3-6" above filter pack)	#8 quartz sand
7- Type of seal	1/4" coated bentonite pellets
a) Quantity used	
8- Grout	
a) Grout mix used	Portland cement/bentonite
b) Method of placement	Tremie
c) Vol. of well casing grout	
Development method	
Development time	
Estimated purge volume	
Comments	

PROJECT NUMBER	WELL NUMBER		
348136.TT.01	MW-530S	SHEET 1	OF 1

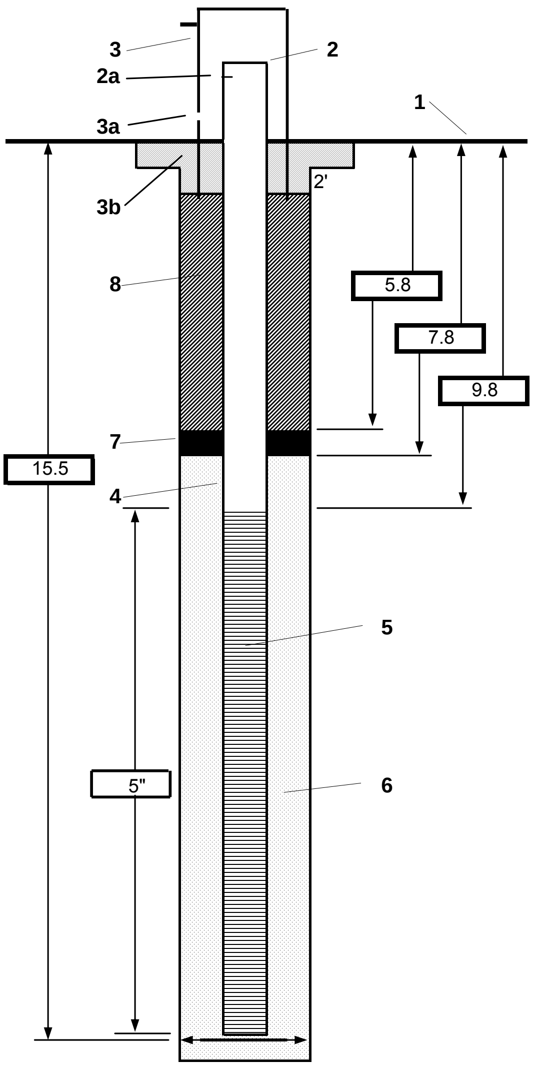
WELL COMPLETION DIAGRAM

PROJECT : OMC Plant 2 LOCATION : Waukegan, IL **2/28/2007**

DRILLING CONTRACTOR : IPS

DRILLING METHOD AND EQUIPMENT USED : HSA

WATER LEVELS : 2.58 ft bgs START : END: LOGGER : I. Mueller



1- Ground elevation at well 583.85 ft amsl

2- Top of casing elevation 583.66 ft amsl
a) vent hole? None

3- Wellhead protection cover type Flush mount
a) weep hole? None
b) concrete pad dimensions

4- Dia./type of well casing 2" PVC

5- Type/slot size of screen 2" PCV
0.010" slot

6- Type screen filter #5 quartz sand filter pack
a) Quantity used

6.5- Fine sand seal (3-6" above filter pack) #8 quartz sand

7- Type of seal 1/4" coated bentonite pellets
a) Quantity used

8- Grout
a) Grout mix used Portland cement/bentonite
b) Method of placement Tremie
c) Vol. of well casing grout

Development method

Development time

Estimated purge volume

Comments

Hydrogeologic Investigation OMC Plant 2, Waukegan, Illinois WA No. 018-RICO-0528, Contract No. EP-S5-06-01

PREPARED FOR:	U.S. Environmental Protection Agency
PREPARED BY:	CH2M HILL
DATE:	March 26, 2008

Introduction

This memorandum documents the hydrogeologic investigation activities associated with the pilot test portion of the remedial investigation (RI) at the Outboard Marine Corporation (OMC) Plant 2 in Waukegan, Illinois. The investigation activities included the measurement of groundwater levels and site-wide groundwater sampling. The hydrogeologic investigation was conducted between August 30 and September 13, 2007.

This memorandum includes the following:

- Description of field activities performed including locations, methods, and deviations from site-specific plans.
- Summary of sample locations, depths, field measurements, and observations.

Field Activities

The field activities conducted and their specific objectives, as discussed in the *Supplemental Field Sampling Plan* (SFSP) (CH2M HILL, 2006), included the following:

- Measuring groundwater levels from monitoring wells locations to verify current groundwater flow directions and rates.
- Collecting groundwater samples from monitoring wells locations to verify current groundwater quality conditions and characterize baseline conditions before the start of the pilot tests.

CH2M HILL and Environmental Design International (EDI) staff conducted groundwater level measurements and groundwater sampling. During the sampling effort, 18 wells were resampled for sulfide, dissolved manganese, and iron because the water was inadvertently filtered into the wrong container compromising the analytical results.

Water Level Measurements

Groundwater measurements were collected from the monitoring wells across the site. Results of the water level measurements are provided in Table 1.

Groundwater Sampling

Upon development of the wells, groundwater sampling was conducted using low-flow methods as described in the SFSP and in accordance with procedures outlined in the *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (U.S. Environmental Protection Agency [USEPA], 2002).

Groundwater was sampled from 80 of the existing 2-inch monitoring wells. The following seven wells were not sampled:

- The integrity of MW-5 and W-12E is compromised; therefore, these wells were not sampled.
- MW-100, MW-101, and MW-102 along the access road east of the OMC Plant 2 building could not be located and were likely damaged during site demolition activities conducted by the City of Waukegan.
- MW-503S contained a light nonaqueous phase liquid (LNAPL).
- MW-517D contained dense nonaqueous phase liquid (DNAPL).

A GeoPump™ peristaltic pump with 0.25-inch ID Teflon®-lined tubing was used for low-flow purging and sampling of monitoring wells. Field parameters, including pH, specific conductance, conductivity, temperature, dissolved oxygen, oxidation reduction potential, and turbidity, were measured at 5-minute intervals using a YSI 6920 equipped with a flow-through cell. The flow rate also was measured at five-minute intervals using a graduated cylinder. Groundwater samples were collected when field parameter readings had stabilized. Field parameter stabilization was determined using guidelines presented in the USEPA publication *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers* (2002). A summary of the final field parameters is presented in Table 2.

Groundwater samples, including trip blanks, an equipment blank, a field blank, duplicates, and matrix spike/matrix spike duplicate samples, were submitted to an independent analytical laboratory. USEPA's Contract Laboratory Program (CLP) analyzed samples for volatile organic compounds (VOCs) and seven monitoring wells samples for polychlorinated biphenyls (PCBs). Groundwater samples also were submitted to CT Laboratories in Baraboo, Wisconsin to be analyzed for alkalinity, chloride, methane, ethane, ethane, nitrate, nitrite, sulfate, sulfide, dissolved manganese and iron, volatile fatty acids, and total organic compounds.

References

CH2M HILL. 2006. *Supplemental Field Sampling Plan, OMC Plant 2*. December.

CH2M HILL. 2004. *Field Sampling Plan, OMC Plant 2, Waukegan, Illinois*. November.

USEPA. 2002. *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers.* Ground Water Forum Issue Paper by Douglas Yeskis and Bernard Zavalam. May.

TABLE 1

Well Data and Groundwater Elevation Table September 2007

OMC Plant 2

Location	Northing	Easting	Top of Casing Elevation (ft amsl)	Elevation Ground Surface (ft amsl)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Total Depth of Borehole (ft bgs)	Top of Screened Interval (ft amsl)	Bottom of Screened Interval (ft amsl)	Screen Midpoint Elevation (ft amsl)	Distance between Screen Midpoints	September 2007 Depth to Water (btoc)	September 2007 Total Depth (btoc)	September 2007 GW Elevation (ft amsl)	September 2007 Vertical Gradient*	Aquifer
W-3	2077258.357	1122162.62	585.70	583.80				583.80	583.80	583.80		3.51	23.98	582.19		Deep
W-4	2076985.208	1122605.961	582.60	582.92				582.92	582.92	582.92		1.76	23.45	580.84		Deep
W-5	2078260.296	1124173.477	588.39	584.90				584.90	584.90	584.90		6.34	35.12	582.05		Deep
W-6	2078201.874	1123483.208	588.27	584.80				584.80	584.80	584.80		5.92	31.98	582.35		Deep
W-7	2078534.26	1123520.355	586.49	583.83				583.83	583.83	583.83		4.44	30.48	582.05		Deep
W-8	2078506.973	1124303.801	586.20	583.39				583.39	583.39	583.39		4.80	34.49	581.40		Deep
W-9	2078227.76	1122458.297	587.36	584.83				584.83	584.83	584.83		4.53	27.2	582.83		Deep
W-10	2078204.816	1122038.228	587.12	584.04				584.04	584.04	584.04		3.73	24.77	583.39		Deep
W-11	2078529.523	1122075.862	588.83	587.03				587.03	587.03	587.03		5.28	26.14	583.55		Deep
W-12	2078476.358	1122590.038	586.78	584.20				584.20	584.20	584.20		4.43	28.90	582.35		Deep
W-12E	2078089.138	1124164.368	584.89	582.81				582.81	582.81	582.81		2.64	6.96	582.25		Shallow
W-13	2077946.78	1124112.094	586.71	584.43				584.43	584.43	584.43		4.33	12.42	582.38		Shallow
MW-3D	2077206.393	1123407.003	587.41	584.88	22.80	27.80		562.08	557.08	559.58		4.73	30.61	582.68		Deep
MW-3S	2077215.94	1123408.144	587.48	584.60				584.60	584.60	584.60	25.02	4.83	6.29	582.65	0.001	Shallow
MW-11D	2077245.328	1122902.936	587.12	584.33	22.73	27.41		561.60	556.92	559.26		5.28	30.65	581.84		Deep
MW-11S	2077246.271	1122898.046	587.19	584.44				584.44	584.44	584.44	25.18	5.42	14.16	581.77	0.003	Shallow
MW-14D	2077184.524	1124068.058	583.19	583.47	25.75	30.75		557.72	552.72	555.22		0.90	29.70	582.29		Deep
MW-14S	2077178.409	1124068.444	583.06	583.44				583.44	583.44	583.44	28.22	0.85	11.25	582.21	0.003	Shallow
MW-15D	2077437.954	1123394.21	584.54	584.78	24.18	28.84		560.60	555.94	558.27		1.83	28.54	582.71		Deep
MW-15S	2077435.285	1123385.296	584.46	584.61				584.61	584.61	584.61	26.34	1.76	11.79	582.70	0.000	Shallow
MW-100	2077636.164	1124037.169	585.04	585.45				585.45	585.45	585.45		NA - well missing	-	-		Shallow
MW-101	2077508.467	1124009.111	585.04	585.16				585.16	585.16	585.16		NA - well missing	-	-		Shallow
MW-102	2077363.114	1123970.728	585.57	585.97				585.97	585.97	585.97		NA - well missing	-	-		Shallow
MW-500D	2078509.357	1123061.775	586.19	583.65	20.50	25.50		563.15	558.15	560.65		3.87	27.04	582.32		Deep
MW-500S	2078505.257	1123062.19	586.18	583.71	1.50	6.50		582.21	577.21	579.71	19.06	3.90	9.12	582.28	0.002	Shallow
MW-501D	2078525.479	1124306.882	585.76	583.29	23.00	28.00		560.29	555.29	557.79		4.31	31.21	581.45		Deep
MW-501S	2078521.487	1124305.877	585.83	583.36	1.50	6.50		581.86	576.86	579.36	21.57	Not Measured - wasps	-	-	NA	Shallow
MW-502D	2078148.787	1122179.083	587.33	584.84	18.00	23.00		566.84	561.84	564.34		4.33	25.81	583.00		Deep
MW-502S	2078143.387	1122179.144	587.44	584.93	2.00	7.00		582.93	577.93	580.43	16.09	4.43	9.85	583.01	-0.001	Shallow
MW-503D	2078103.777	1122623.998	584.63	584.86	20.00	25.00		564.86	559.86	562.36		1.76	23.56	582.87		Deep
MW-503S	2078099.837	1122624.038	584.66	584.91	2.00	7.00		582.91	577.91	580.41	18.05	LNAPL	Not Measured	-	NA	Shallow
MW-504D	2078002.82	1122879.744	588.16	588.42	24.00	29.00		564.42	559.42	561.92		5.46	28.11	582.70		Deep
MW-504S	2077999.093	1122879.744	588.23	588.42	4.00	9.00		584.42	579.42	581.92	20.00	5.52	9.33	582.71	-0.0005	Shallow
MW-505D	2077972.289	1122261.97	587.97	588.36	22.00	27.00		566.36	561.36	563.86		4.95	25.31	583.02		Deep
MW-505S	2077968.592	1122261.602	588.13	588.36	4.00	9.00		584.36	579.36	581.86	18.00	5.11	8.69	583.02	0.000	Shallow
MW-506D	2077939.265	1122517.2	588.19	588.42	23.00	28.00		565.42	560.42	562.92		5.40	27.48	582.79		Deep
MW-506S	2077937.359	1122513.952	588.18	588.42	4.00	9.00		584.42	579.42	581.92	19.00	5.38	9.17	582.80	-0.001	Shallow
MW-507D	2077793.084	1123101.017	586.34	583.93	20.00	25.00		563.93	558.93	561.43		3.67	26.00	582.67		Deep
MW-507S	2077789.18	1123101.426	586.32	583.88	2.00	7.00		581.88	576.88	579.38	17.95	3.69	9.63	582.63	0.002	Shallow
MW-508D	2077804.935	1124071.789	584.68	584.96	24.00	29.00		560.96	555.96	558.46		2.22	29.31	582.46		Deep
MW-508S	2077800.424	1124071.125	584.67	584.93	1.50	6.50		583.43	578.43	580.93	22.47	2.14	6.19	582.53	-0.003	Shallow
MW-509D	2077826.005	1121879.859	584.19	584.41	14.50	19.50		569.91	564.91	567.41		0.75	19.28	583.44		Deep
MW-509S	2077821.794	1121879.615	584.22	584.42	2.00	7.00		582.42	577.42	579.92	12.51	0.75	6.36	583.47	-0.002	Shallow
MW-510D	2077652.863	1122315.562	588.07	588.33	22.00	27.00		566.33	561.33	563.83		5.43	27.22	582.64		Deep
MW-510S	2077648.18	1122316.212	588.05	588.33	4.00	9.00		584.33	579.33	581.83	18.00	5.35	9.17	582.70	-0.003	Shallow

TABLE 1

Well Data and Groundwater Elevation Table September 2007

OMC Plant 2

Location	Northing	Easting	Top of Casing Elevation (ft amsl)	Elevation Ground Surface (ft amsl)	Top of Screened Interval (ft bgs)	Bottom of Screened Interval (ft bgs)	Total Depth of Borehole (ft bgs)	Top of Screened Interval (ft amsl)	Bottom of Screened Interval (ft amsl)	Screen Midpoint Elevation (ft amsl)	Distance between Screen Midpoints	September 2007 Depth to Water (btoc)	September 2007 Total Depth (btoc)	September 2007 GW Elevation (ft amsl)	September 2007 Vertical Gradient*	Aquifer
MW-511D	2077649.349	1122929.585	588.22	588.41	23.00	28.00		565.41	560.41	562.91		5.67	28.10	582.55		Deep
MW-511S	2077646.103	1122929.854	588.15	588.41	4.00	9.00		584.41	579.41	581.91	19.00	5.61	9.21	582.54	0.001	Shallow
MW-512D	2077505.071	1123000.775	584.60	584.86	20.00	25.00		564.86	559.86	562.36		2.24	25.37	582.36		Deep
MW-512S	2077500.468	1123000.779	584.56	584.83	2.50	7.50		582.33	577.33	579.83	17.47	2.60	7.27	581.96	0.023	Shallow
MW-513D	2077401.569	1122454.081	585.29	585.54	20.50	25.00		565.04	560.54	562.79		3.07	23.24	582.22		Deep
MW-513S	2077397.318	1122453.985	585.23	585.44	2.50	7.50		582.94	577.94	580.44	17.65	3.02	7.56	582.21	0.001	Shallow
MW-514D	2077339.642	1122819.583	584.70	584.92	20.00	25.00		564.92	559.92	562.42		2.74	24.84	581.96		Deep
MW-514S	2077335.663	1122819.217	584.70	584.70	2.50	7.50		582.20	577.20	579.70	17.28	2.75	6.88	581.95	0.001	Shallow
MW-515D	2077304.772	1123199.545	583.90	583.88	21.00	26.00		562.88	557.88	560.38		1.33	26.12	582.57		Deep
MW-515S	2077299.68	1123198.876	583.71	583.97	3.00	8.00		580.97	575.97	578.47	18.09	4.47	7.81	579.24	0.184	Shallow
MW-516D	2076957.466	1122803.173	583.78	584.04	20.00	25.00		564.04	559.04	561.54		3.41	25.31	580.37		Deep
MW-516S	2076955.733	1122807.52	583.80	584.08	3.00	8.00		581.08	576.08	578.58	17.04	3.40	8.20	580.40	-0.002	Shallow
MW-517D	2077499.263	1121981.581	586.64	584.19	15.00	20.00		569.19	564.19	566.69		3.62	22.70	583.02		Deep
MW-517S	2077495.319	1121983.103	586.64	584.18	2.50	7.50		581.68	576.68	579.18	12.49	3.66	9.69	582.98	0.003	Shallow
MW-518D	2078092.125	1122539.808	588.00	588.34	21.52	26.52	27.22	566.82	561.82	564.32		5.25	26.72	582.75		Deep
MW-518S	2078089.892	1122538.404	587.95	588.33	5.32	10.32	11.02	583.01	578.01	580.51	16.19	5.21	10.52	582.74	0.001	Shallow
MW-519D	2078038.569	1122118.919	587.84	588.16	20.76	25.76	26.46	567.40	562.40	564.90		4.73	25.96	583.11		Deep
MW-519S	2078034.929	1122118.772	587.82	588.17	9.63	14.63	15.33	578.54	573.54	576.04	11.14	4.69	14.83	583.13	-0.002	Shallow
MW-520D	2077928.381	1122347.485	587.81	588.13	20.85	25.85	26.55	567.28	562.28	564.78		4.95	26.05	582.86		Deep
MW-520S	2077930.531	1122347.432	587.67	588.10	9.92	14.92	15.62	578.18	573.18	575.68	10.90	4.81	15.12	582.86	0.000	Shallow
MW-521D	2077850.456	1122254.048	588.08	588.33	20.28	25.28	25.98	568.05	563.05	565.55		5.18	25.48	582.90		Deep
MW-521S	2077847.302	1122254.346	587.90	588.33	9.92	14.92	15.62	578.41	573.41	575.91	10.36	4.99	15.12	582.91	0.000	Shallow
MW-522D	2077902.211	1122200.042	588.06	588.33	20.75	25.75	26.45	567.58	562.58	565.08		5.07	25.95	582.99		Deep
MW-522S	2077899.365	1122200.122	588.04	588.35	10.09	15.09	15.79	578.26	573.26	575.76	10.68	5.04	15.29	583.00	-0.001	Shallow
MW-523D	2077954.427	1122987.67	588.14	585.55	23.44	28.44	29.14	562.11	557.11	559.61		5.40	28.64	582.74		Deep
MW-523S	2077957.289	1122987.527	588.18	585.55	3.57	8.57	9.27	581.98	576.98	579.48	19.88	5.54	8.77	582.64	0.005	Shallow
MW-524D			Not installed - DNAPL									DNAPL	-	-		Deep
MW-524S	2077895.538	1123004.565	587.99	585.43	4.54	9.54	10.24	580.89	575.89	578.39	578.39	5.29	9.74	582.70	NA	Shallow
MW-525D	2077849.557	1122991.269	588.18	585.62	23.77	28.77	29.47	561.85	556.85	559.35		5.50	28.97	582.68		Deep
MW-525S	2077849.625	1122986.045	588.32	585.75	4.62	9.62	10.32	581.13	576.13	578.63	19.28	6.62	9.82	581.70	0.051	Shallow
MW-526D	2077886.367	1123020.119	587.90	585.13	23.70	28.70	29.40	561.43	556.43	558.93		5.20	28.90	582.70		Deep
MW-526S	2077889.018	1123020.233	587.89	585.14	6.04	11.04	11.74	579.10	574.10	576.60	17.67	5.18	11.24	582.71	0.000	Shallow
MW-527D	2077342.8	1122753.089	584.31	584.57	21.06	26.06	26.76	563.51	558.51	561.01		2.44	26.26	581.87		Deep
MW-527S	2077342.224	1122754.821	584.29	584.49	2.52	7.52	8.22	581.97	576.97	579.47	18.46	2.38	7.72	581.91	-0.002	Shallow
MW-528D	2077357.592	1122677.247	586.40	586.62	21.76	26.76	27.46	564.86	559.86	562.36		4.43	26.96	581.97		Deep
MW-528S	2077360.259	1122677.116	586.46	586.76	4.90	9.90	10.60	581.86	576.86	579.36	17.00	4.46	10.10	582.00	-0.002	Shallow
MW-529D	2077399.272	1122774.202	586.16	586.51	22.89	27.89	28.59	563.62	558.62	561.12		4.13	28.09	582.03		Deep
MW-529S	2077402.235	1122774.571	586.06	586.46	4.75	9.75	10.45	581.71	576.71	579.21	18.08	4.02	9.95	582.04	0.000	Shallow
MW-530D			NA		16.63	21.63	22.33					0.90	21.83	-		Deep
MW-530S	2077380.732	1122046.715	583.66	583.85	1.98	6.98	7.68	581.87	576.87	579.37	579.37	1.01	7.18	582.65		Shallow

Survey coordinates are NAD 1983 State Plane Illinois East FIPS 1201 Feet

ft amsl = feet above mean sea level

ft btoc = feet below top of casing

*Negative value for vertical gradient denotes downward direction

TABLE 2
Groundwater Field Parameters Summary
OMC Plant 2 Site

Well ID	Well Depth (ft)	Initial DTW (ft)	Ending Parameters DTW (ft)	Flow Rate (mL/min)	Temp (C)	pH	Specific Conductance (µS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
Existing Monitoring Wells										
W-1	25.58	4.25	4.40	320.0	15.36	7	2.295	-124.7	0.21	7.62
W-2	25.59	NA	5.17	350.0	15.44	6	4.602	-127.0	0.43	NA
W-2*	25.58	5.05	5.10	400.0	14.94	7	2.582	-136.0	0.34	NA
W-3	23.98	3.80	3.69	300.0	16.63	7	2.902	-157.2	1.27	0.90
W-3*	23.98	3.67	3.79	300.0	15.25	7	3.040	-116.7	0.33	NA
W-4	23.45	1.97	2.02	350.0	20.34	7	1.696	-147.0	1.96	5.70
W-5	35.12	6.63	6.80	350.0	15.03	7	0.936	-169.0	0.22	5.40
W-6	31.98	6.30	6.45	360.0	14.72	7	3.532	-139.7	0.59	3.40
W-7	30.48	4.85	4.97	360.0	16.51	7	1.342	-135.1	0.55	0.00
W-8	34.49	5.16	5.11	200.0	14.58	7	1.172	-121.4	0.73	1.55
W-9	27.20	5.01	5.04	375.0	17.56	7	1.586	-107.9	0.22	3.40
W-10	24.77	4.00	4.10	220.0	17.85	7	1.871	-98.1	0.73	5.30
W-11	26.14	5.50	5.60	400.0	15.46	7	1.772	-117.0	0.37	7.40
W-12	28.90	4.65	4.76	200.0	17.67	7	1.250	-111.3	0.78	2.30
W-13	12.42	4.85	4.92	380.0	20.30	7	0.675	-167.4	0.58	1.22
MW-5	11.63									
MW-3S	6.29	5.12	5.14	320.0	19.32	7	0.573	-114.7	4.90	0.88
MW-3D	30.61	5.05	5.13	220.0	16.38	8	6.896	-154.2	0.31	4.23
MW-11S	14.16	5.64	5.58	240.0	21.10	7	0.941	-86.2	0.71	7.35
MW-11D	30.65	5.38	5.48	260.0	16.74	7	1.750	-168.0	0.27	NA
MW-14S	11.25	0.96	0.96	200.0	19.55	7	0.567	-110.5	0.10	2.49
MW-14D	29.70	NA	1.22	280.0	14.30	8	5.147	-168.7	0.40	2.60
MW-15S	11.79	1.85	1.91	325.0	17.23	7	0.591	-58.0	0.38	5.20
MW-15D	28.54	2.01	2.11	425.0	13.81	7	1.572	-128.3	0.35	8.30
Chemical Storage Area										
MW-509S	6.36	0.72	0.74	320.0	22.02	7	1.176	-117.9	0.66	0.61
MW-509D	19.28	0.60	0.78	350.0	17.25	7	2.446	-103.8	-0.52	7.84
MW-517S	9.69	4.89	4.93	300.0	20.48	7	1.959	-108.6	1.33	0.63
MW-517S*	9.69	3.83	3.85	300.0	21.19	7	0.908	-147.4	1.15	0.00
MW-517D	22.70	Not Sampled - DNAPL present								
MW-530S	7.18	1.19	1.10	300.0	22.54	7	1.168	-119.90	0.90	0.56
MW-530S*	7.18	1.10	1.10	200.0	23.09	7	0.651	-143.50	1.05	2.03
MW-530D	21.83	1.07	1.12	300.0	17.56	7	3.305	-129.80	3.18	-0.50
MW-530D*	21.83	0.91	1.00	200.0	18.86	7	1.720	-129.60	1.28	3.80
Outside of Chip Dock Area										
MW-502S	9.85	4.80	4.83	265.0	21.28	7	0.848	-84.9	3.66	1.67
MW-502D	25.81	4.75	4.75	280.0	16.21	7	2.927	-103.80	4.30	15.60
Outside of Chip Room										
MW-503S	NA	Not Sampled - LNAPL present								
MW-503D	23.56	2.02	2.15	350.0	15.06	7	3.300	-86.3	-0.22	3.50
Parking Lot between Old Die Cast Area and New Die Cast Area										
MW-507S	9.63	3.98	4.01	250.0	23.11	7	0.543	-120.7	-0.37	0.89
MW-507D	26	3.85	4.09	270.0	17.36	7	1.250	-118.3	1.42	1.76
MW-523S	8.77	5.76	5.75	400.0	24.36	7	0.672	56.8	3.32	0.29
MW-523S*	8.77	5.85	5.86	320.0	22.90	7	0.620	74.1	1.41	NA
MW-523D	28.64	5.66	5.75	400.0	16.62	7	3.617	-112.7	3.43	-0.10
MW-523D*	28.64	5.75	5.84	320.0	15.95	7	2.153	-109.3	0.45	NA
MW-524S	9.74	5.56	5.57	300.0	25.11	7	0.973	85.1	3.66	0.00
MW-524S*	9.74	5.65	5.66	260.0	22.71	8	0.689	23.4	3.79	1.43
MW-525S	9.82	5.91	5.91	280.0	22.72	6	0.479	393.5	4.41	0.33
MW-525D	28.97	5.78	5.86	280	17.58	6.72	1.677	-90.1	0.26	0.83
MW-526S	11.24	5.46	4.49	350.0	23.78	7	0.662	194.2	6.49	0.50
MW-526D	28.90	5.48	5.57	250.0	17.71	7	1.817	-151.2	19.10	1.90
Near Corporate Offices										
MW-513S	7.56	3.23	3.25	400.0	20.50	7	0.851	-117.0	0.20	1.64
MW-513D	23.24	3.29	3.39	350.0	15.46	7	1.367	-151.8	-9.47	2.38
MW-514S	6.88	2.97	3.01	400.0	19.62	7	1.399	31.9	-10.18	0.30
MW-514D	24.84	2.95	3.02	360.0	15.08	7	1.581	-135.0	0.23	2.00
MW-527S	7.72	2.60	2.6	250.0	19.66	7	1.130	150.9	1.05	0.30
MW-527D	26.26	2.63	2.71	260.0	14.71	7	3.020	-263.0	-0.44	1.00
MW-528S	10.10	4.67	4.7	350.0	20.18	7	1.320	-300.0	0.95	0.40
MW-528D	26.96	4.65	4.75	350.0	15.54	7	3.313	-103.3	0.18	1.80
MW-529S	9.95	4.24	4.25	260.0	17.02	7	1.370	19.9	0.96	0.60
MW-529D	28.09	4.31	4.42	220.0	15.07	7	2.495	-308.0	-1.90	2.30
Larson Marine Property - Near Slip 4										
MW-515S (north of Seahorse Drive)	7.81									
MW-515D (north of Seahorse Drive)	26.12	1.45	1.50	200.0	13.94	7	3.641	-139.5	1.16	2.19
MW-516S	8.20	3.59	3.64	300.0	21.97	7	1.178	-45.8	1.90	-1.00
MW-516S *	8.20	3.70	3.71	300.0	20.95	7	1.377	-15.1	0.43	1.33
MW-516D	25.31	3.70	3.91	400.0	14.32	7	8.228	-130.2	0.56	NA
MW-516D*	25.31	3.73	3.89	300.0	14.72	7	10.240	-80.9	0.29	1.63

TABLE 2

Groundwater Field Parameters Summary

OMC Plant 2 Site

Well ID	Well Depth (ft)	Initial DTW (ft)	Ending Parameters: DTW (ft)	Flow Rate (mL/min)	Temp (C)	pH	Specific Conductance (μS/cm)	ORP (mV)	DO (mg/L)	Turbidity (NTU)
Within the Plant 2 Building										
MW-504S	9.33	5.72	5.76	240.0	17.34	7	1.009	-30.7	1.17	2.90
MW-504S*	9.33	5.89	5.93	350.0	16.85	7	0.977	-37.0	0.33	NA
MW-504D	28.11	5.07	5.83	320.0	13.34	7	1.984	-120.3	0.92	9.53
MW-504D*	28.11	5.82	5.99	325.0	13.72	7	2.389	-139.4	0.12	21.80
MW-505S	8.69	5.52	5.50	320.0	16.29	7	1.134	-95.4	0.44	4.70
MW-505S*	8.69	5.36	5.49	280.0	16.04	7	1.315	-81.1	0.74	2.94
MW-505D	25.31	5.22	5.23	240.0	15.34	7	2.813	-106.8	2.00	6.20
MW-505D*	25.31	5.24	5.30	280.0	14.98	7	1.557	-120.3	0.35	2.32
MW-506S	9.17	5.62	5.66	320.0	17.00	7	1.112	-80.0	0.01	1.84
MW-506D	27.48	5.64	5.78	300.0	15.26	7	1.827	-111.8	0.24	6.37
MW-510S	9.17	5.60	5.65	300.0	17.21	7	1.006	31.9	2.20	1.89
MW-510D	27.22	5.54	5.65	300.0	15.45	8	1.763	-158.7	0.19	16.70
MW-511S	9.21	5.85	5.87	180.0	17.46	7	0.697	23.7	0.95	1.50
MW-511D	28.10	5.91	5.95	180.0	15.74	7	0.827	-128.2	1.39	5.62
MW-518S	10.52	5.34	5.49	320.0	15.36	7	0.959	-100.0	0.29	11.10
MW-518S*	10.52	1.57	1.57	300.0	20.13	7	0.599	-119.9	0.62	1.62
MW-518S**	10.52	5.57	5.6	200.0	15.87	7	0.964	-114.0	0.93	2.70
MW-518D	26.72	5.43	5.61	400.0	14.38	7	5.150	-104.2	2.68	5.90
MW-518D*	26.72	5.70	5.64	200.0	13.83	7	2.971	-100.1	1.55	2.90
MW-519S	14.83	4.60	4.94	200.0	15.58	7	1.450	-160.0	0.12	2.00
MW-519D	25.96	4.97	5.01	200.0	14.87	7	1.383	-158.5	0.72	1.41
MW-520S	15.12	5.08	5.1	360.0	16.01	7	1.899	-147.6	1.36	-0.40
MW-520S*	15.12	5.11	5.15	350.0	15.57	7	1.126	-166.0	0.53	5.30
MW-520D	26.05	5.19	5.35	240.0	14.56	7	1.624	-96.0	0.11	NA
MW-520D*	26.05	5.26	5.4	350.0	14.98	7	1.547	-99.4	0.28	2.80
MW-521S	15.12	5.25	5.29	300.0	15.89	7	1.546	-229.3	0.22	1.93
MW-521D	25.48	5.43	5.5	400.0	15.00	7	1.829	-173.0	0.18	3.86
MW-522S	15.29	5.30	5.32	200.0	15.79	7	1.617	-154.60	1.16	2.73
MW-522D	25.95	5.28	5.4	300.0	14.91	7	1.770	-130.00	-0.28	4.36
Additonal Monitoring Wells Locations										
MW-508S (along eastern access road)	6.19	2.67	2.70	260.0	21.06	7	0.666	-88.4	0.09	7.06
MW-508D (along eastern access road)	29.31	2.64	2.70	240.0	14.72	8	0.520	-164.4	0.63	7.36
MW-512S (south of Triax Building)	7.27	2.45	2.50	450.0	26.24	7	0.720	77.2	0.17	0.65
MW-512D (south of Triax Building)	25.37	2.47	2.63	400.0	17.96	7	1.322	-158.7	-20.17	4.88
Replacement Monitoring Well Locations										
MW-500S	9.12	4.29	4.32	350.0	23.28	7	1.561	-151.1	-0.70	5.50
MW-500D	27.04	4.30	4.37	280.0	15.74	7	5.589	-135.1	0.22	10.90
MW-501S	NA	4.60	4.66	220.0	20.69	7	0.942	-89.6	1.40	0.47
MW-501D	31.32*	4.55	4.65	7.5	5.40	788	0.520	1.5	-124.60	150.00
MW-501D	31.21	4.68	4.70	220.0	15.91	7	1.843	-134.7	2.22	1.16

Notes:

a. DTW = depth to water

b. All depth to water measurements are below top of casing.

c. Temp = temperature

d. DO = dissolved oxygen

e. NTU = National Turbidity Units

f. ORP = Oxidation Reduction Potential

g. psi = pounds per square inch

h. NS = Not Sampled

i. * = reanalysis parameters

j. NA = not available

Dense Non–Aqueous Phase Liquid Investigation OMC Plant 2 (Operable Unit 4), Waukegan, Illinois WA No. 018-RICO-0528, Contract No. EP-S5-06-01

PREPARED FOR: USEPA

PREPARED BY: CH2M HILL

DATE: March 1, 2007

Introduction

This memorandum documents the field activities associated with the dense non–aqueous phase liquid (DNAPL) investigation conducted as part of the pilot testing of in situ remedial technologies for the groundwater remedy at the Outboard Marine Corporation Plant 2 (OMC Plant 2) in Waukegan, Illinois.

A membrane interface probe (MIP) investigation conducted during the remedial investigation (RI) identified DNAPL at a location outside the plant in the courtyard north of the trim building just east of the die cast area at MIP-027. Two soil borings (SO-026 and SO-057) were completed in that area. DNAPL was encountered at one location (MIP-027/SO-057) consisting of 1,600 grams per kilogram (g/kg) of trichloroethene (TCE). The extent of the DNAPL was investigated by advancing four additional direct-push offset locations within a 50-foot radius of MIP-027/SO-057. There was no visual evidence of DNAPL at any of the offset locations.

Because of the presence of DNAPL, a pilot test program was designed to determine if in situ soil mixing using a chemical reducing agent would provide effective treatment of the DNAPL. The area around MIP-027/SO-057 was targeted for the soil mixing pilot testing (Figure 1).

This DNAPL investigation was implemented to define the horizontal and vertical extent and thickness of the DNAPL and to collect soil, groundwater, and DNAPL samples for bench testing to design the soil mixing pilot test. Representative samples were submitted to Colorado State University to perform a bench test to optimize the effectiveness of in situ soil mixing. The DNAPL investigation was conducted between November 8 and December 21, 2006.

This memorandum contains the following:

- Description of field activities performed, including locations, methods, and deviations from site-specific plans
- Summary table of sample locations, depths, field measurements, and observations
- Boring logs describing materials encountered at each location

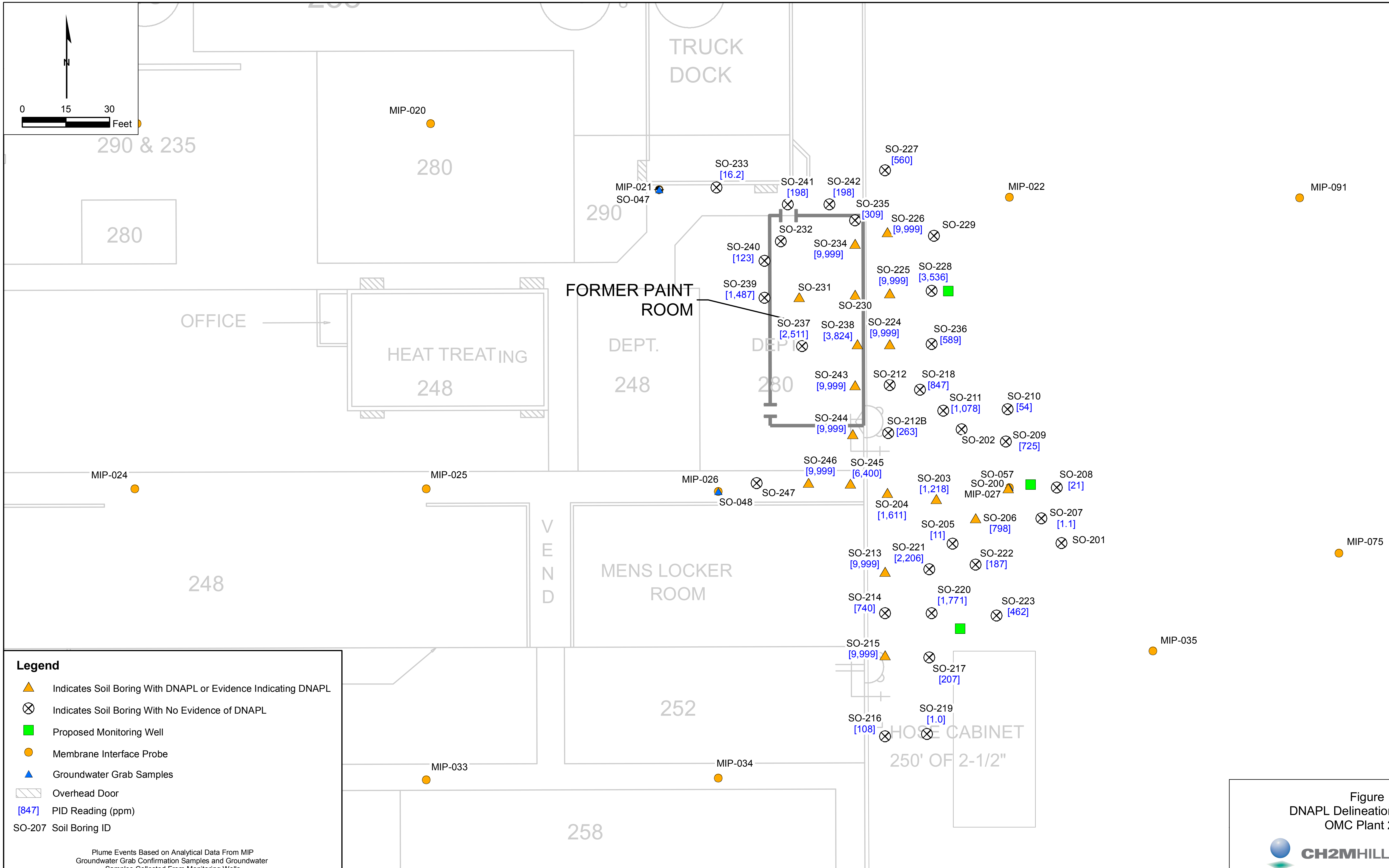


Figure 1
DNAPL Delineation
OMC Plant 2

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Field Activities

The DNAPL investigation, described in the *Supplemental Field Sampling Plan* (SFSP; CH2M HILL, 2006), focused on the area outside the building where DNAPL was identified during the RI. The field activities and their specific objectives include:

- Defining areal extent of soils potentially contaminated with DNAPL
- Characterizing the lithologic properties of site soils
- Collecting DNAPL and soil samples for bench scale testing

Soil and Groundwater Sampling

A limited subsurface investigation using direct-push technology (DPT) methods (e.g., Geoprobe®) was conducted by Innovative Probing Solutions (IPS) of Mt. Vernon, Illinois. The focused investigation included advancing 48 borings to the base of the aquifer, with 30 in the parking lot outside the building (SO-200 through SO-229) and 18 in the former paint room and vicinity (SO-230 through SO-247). Continuous soil samples were collected from the ground surface to the top of the till (that is, to a depth of roughly 30 feet below ground). Boring SO-200 was installed at the original RI location (MIP027/SO-057) to verify the presence DNAPL encountered during the RI. Eight more soil borings were installed in a radial pattern, 25 feet from boring SO-200.

Offset boring locations were advanced at 10- to 25-foot increments based on the presence or absence of DNAPL in the soil samples as determined by visual observations and total organic vapor measurements. Initially, a groundwater grab sample was to be collected at each boring location to visually examine for the presence of DNAPL. However, to streamline the delineation process, the presence or absence of DNAPL was evaluated based on elevated organic vapor meter (OVM) readings measured during the field screening procedure, i.e. a step-out boring was deemed necessary if a maximum OVM reading of > 9,999 ppm was measured from the soil sample. Figure 1 illustrates the extent of the DNAPL investigation. Table 1 lists the soil borings.

Soil Sampling Procedures. Soils at each location were continuously sampled using a Geoprobe macrocore sampler with a disposable acetate liner from ground surface to the top of the till, as indicated by direct-push refusal.

The soil samples were logged using ASTM D-2487, Unified Soil Classification System. Observations during sampling activities, including OVM readings, soil staining, odors, and sheen, were also noted on the soil boring logs. Soil samples sent to Colorado State University for bench testing were not logged by CH2M HILL staff, with the exception of the interval that represents the top of the till. Soil samples where ground water grab samples were collected were not logged; however, boring SO-203 was re-advanced and logged from 24 to 27.7 feet. Soil samples were not collected for laboratory analysis. Boring location coordinates (northing and easting) were determined by measuring the position from known survey locations with a measuring tape and plotting in a geographical information system. The soil boring logs are included in Attachment 1.

The soil samples were logged, field screened using an OVM and examined for visual indications of mobile or residual DNAPL. Samples were not collected for laboratory analysis. The sampling procedures and equipment applicable to these activities were

TABLE 1
Summary of DNAPL Area Investigation
OMC Plant 2

Boring ID	Date Completed	Depth to Till (ft)	End of Boring (EOB)	Comments/Significant Observations
SO-200	11/21/2006	NA	32	collected groundwater grab sample; slight sheen visible; DNAPL not observed
SO-200A	11/27/2006	28	28	
SO-201	11/21/2006	NA	32	collected groundwater grab sample; DNAPL not observed
SO-202	11/22/2006	27.5	28	collected groundwater grab sample; purge water had strong odor; DNAPL not observed
SO-203	11/22/2006 & 11/28/2006	~26.5	27.7	8 oz. DNAPL sample collected; DNAPL is amber-colored, moderately viscous with a strong odor
SO-204	11/28/2006	~26.5	27.7	
SO-205	11/28/2006	~26.5	28	
SO-206	11/29/2006	26.7	27	DNAPL observed @ 24-28' interval
SO-207	11/29/2006	25.5	26.5	
SO-208	11/30/2006	26	26.3	
SO-209	11/30/2006	25.5	26	
SO-210	12/5/2006	25	26	
SO-211	12/5/2006	25.6	25.9	
SO-212B	12/5/2006	NA	25.8	
SO-213	12/6/2006	25.5	26	PID >9999 ppm @ 24-28' interval
SO-214	12/6/2006	26.2	26.5	
SO-215	12/6/2006	26.5	27	PID >9999 ppm @ 24-28' interval
SO-216	12/6/2006	24.5	27.5	
SO-217	12/8/2006	25	26.8	
SO-218	12/8/2006	26	26	
SO-219	12/11/2006	25.4	26.6	
SO-220	12/11/2006	25.6	26.2	
SO-221	12/12/2006	25.9	26.2	
SO-222	12/12/2006	25.4	26.8	
SO-223	12/13/2006	24.8	26.3	
SO-224	12/13/2006	25.4	25.9	PID >9999 ppm @ 20-24' interval; strong odor and sheen at 23' bgs
SO-225	12/13/2006	28.7	31.5	PID >9999 ppm @ 28-32' interval; sheen; liner stained pale green from 31-32' interval
SO-226	13/14/2006	25.95	26.2	PID >9999 ppm @ 20' interval, sheen
SO-227	12/14/2006	25.9	26.5	
SO-228	12/14/2006	26.4	27	
SO-229	12/15/2006	26	28	
SO-230	12/15/2006	29	30.5	PID >9999 ppm @ 20-26' interval
SO-231	12/15/2006	28.75	30.5	PID >9999 ppm @ 24-26' interval
SO-232	12/18/2006	NA	7	Refusal at 7'
SO-233	12/18/2006	30	30	
SO-234	12/18/2006	29	30	PID >9999 ppm @ 16-21' interval
SO-235	12/18/2006	30.5	30.5	
SO-236	12/19/2006	27	27	
SO-237	12/19/2006	29	29.2	
SO-238	12/19/2006	29.5	29.5	
SO-239	12/20/2006	29.6	29.8	
SO-240	12/20/2006	29.5	30.2	
SO-241	12/20/2006	29	29.5	
SO-242	12/20/2006	29.5	29.6	
SO-243	12/21/2006	29.5	29.9	PID >9999 ppm @ 26' interval
SO-244	12/21/2006	29.3	29.3	PID >9999 ppm @ 26' interval
SO-245	12/21/2006	29.7	30	
SO-246	12/21/2006	29.6	30	PID >9999 ppm @ 26' interval
SO-247	12/21/2006	29.4	29.6	

NA - not available

conducted in accordance with the Field Operating Procedures included in the November 2004 *Field Sampling Plan* (FSP; CH2M HILL, 2004a).

Groundwater and DNAPL Sampling Procedures. Discrete groundwater samples were collected from boring locations SO-200 through SO-203 to evaluate for the presence of mobile or residual DNAPL. The borings were not sampled but were advanced in the subsurface until boring refusal at the till boundary. A screen point sampler was then exposed to enable the collection of groundwater grab samples from the base of the aquifer using disposable tubing with a ball and check valve.

DNAPL Sampling Procedures. An amber-colored DNAPL with an oily appearance was observed in the groundwater grab sample from boring SO-203. DNAPL was collected from boring location SO-203 using the same method as the groundwater; however, the sample was decanted to remove water and sediment. An 8-ounce DNAPL sample was sent to Colorado State University for use in the bench scale testing.

Decontamination and Investigation-Derived Waste Procedures. Sampling equipment was decontaminated in accordance with FOP-17, *Decontamination of Drilling Rigs and Equipment.* The solid and liquid IDW generated during the fieldwork were containerized and will be sampled, characterized, and disposed of following the completion of the pilot test activities and in accordance with *Investigation-Derived Waste Management Plan* (CH2M HILL 2004b).

Monitoring Well Installation

Based on the extent of DNAPL observed in the area, three monitoring well locations were identified to monitor changes in groundwater quality resulting from soil mixing activities. Each well nest consists of a shallow well installed at the water table (well depth of 15 feet) and a deep well installed at the top of the till (well depth of about 30 feet). The 2-inch monitoring wells were installed using hollow-stem auger techniques, constructed of polyvinyl chloride casing and stainless steel well screens, and developed following the same procedures as for the RI monitoring wells. The new monitoring wells will be included in the overall baseline groundwater sampling event and with the post-injection performance monitoring program for enhanced in situ bioremediation. A hydrogeologic investigation summary report will summarize the monitoring well installation activities.

References

ASTM Method D-2487.

CH2M HILL. 2006. Supplemental *Field Sampling Plan, OMC Plant 2, Waukegan, Illinois, Final*. December.

CH2M HILL. 2004a. *Field Sampling Plan, OMC Plant 2, Waukegan, Illinois*. November.

CH2M HILL. 2004b. *Investigation-Derived Waste Management Plan*. September.

Attachment 1

Soil Boring Logs

OMC Plant 2—Geological Investigations

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-203	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 25' W of MIP-027
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 11/27/06 FINISH: 11/28/06 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1						0-12 ft bgs Not Sampled	
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13	12'-16'	1	3.6/4.0				
14							
15							
16							
17	16'-20'	2	3.6/4.0				
18							
19							
20							
21	20'-24'	3	3.6/4.0				
22							
23							
24							
25	24'-28'	4	3.7/4.0		24.0 ft bgs - Silty fine Sand (SM), gray, grain size decreases with depth, wet.	Strong solvent odor.	1,218
26							1,100
27							687
28							548
29					**EOB @27.7 ft bgs**		
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-204	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' W of SO-203
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 11/28/2006 FINISH: 11/28/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	3.0/4.0				
2							
3							
4							
5	4'-8'	2	3.4/4.0				
6							
7							
8							
9	8'-12'	3	4.0/4.0				
10							
11							
12							
13	12'-16'	4	3.7/4.0				
14							
15							
16							
17	16'-20'	5	3.5/4.0				
18							
19							
20							
21	20'-24'	6	3.6/4.0				
22							
23							
24					24.0 ft bgs - Fine Sand with some Silt (SM), gray/brown, trace rounded pebbles present, wet.	Strong solvent odor.	167
25	24'-28'	7	3.7/4.0				321
26							667
27							309 1,611
28					**EOB @27.7 ft bgs**		
29							
30							

CH2MHILL	**PROJECT NUMBER** 348136.TT.01	**BORING NUMBER** SO-205 SHEET 1 OF 1

SOIL BORING LOG

PROJECT:	**OMC Plant 2**	LOCATION:	25' SW of MIP-027
ELEVATION:		DRILLING CONTRACTOR:	**IPS**
DRILLING METHOD AND EQUIPMENT USED:	**Geoprobe**		
WATER LEVELS: 4.75 ft bgs	START: 11/28/2006 FINISH: 11/28/2006	LOGGER:	**K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.4
1	0'-4'	1	3.0/4.0		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" quartz gravel.		0.6
2							
					1.25 ft bgs - Fine Sand (SP), gray/brown, moist, trace		0.2
3					0.25" to 1" rounded gravel.		
					2.0 ft bgs - no gravel, light brown.		0.6
4							
					4.5 ft bgs - dark brown, trace 0.25" rounded gravel.		0.2
5	4'-8'	2	4.0/4.0		4.75 ft bgs - fine to medium sand, light brown, wet,	Groundwater @ 4.75 ft bgs	
					firm, micaceous.		0.3
6					5.0 ft bgs - 3" layer of 0.5" to 1" subrounded gravel,		
					decreasing medium sand with depth.		0.5
7							
							0.4
8							
							0.5
9	8'-12'	3	2.8/4.0				
					9.0 ft bgs - fine to medium sand, 0.5" to 1"		2.0
10					subrounded to rounded gravel.		
							5
11							
							0.5
12							
							0.4
13	12'-16'	4	3.5/4.0				
							0.3
14							
							0.6
15							
							1.2
16							0.6
					16.0 ft bgs - 0.125" to 0.5" subrounded gravel.		0.8
17	16'-20'	5	3.5/4.0				
							1.2
18							
							0.8
19							
					19.25 ft bgs - Silty fine Sand (SM), light gray, wet,		0.7
20					firm to hard.		0.3
							9.6
21	20'-24'	6	3.5/4.0				
					21.0 ft bgs - dark gray.		5.7
22							224
							190
23							
							194
24							110
					24.0 ft bgs - gray/brown, pebbles present in lower 0.5' of		10.5
25	24'-28'	7	3.5/4.0		section, silt concentration increases and color		
					becomes more gray with depth.		7.5
26							
							6
27							
							6
28							
					EOB @27.5 ft bgs		
29							
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-206	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' NE of SO-205
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 6.0 ft bgs START: 11/28/2006 FINISH: 11/29/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	3.0/4.0				
2							
3							
4							
5	4'-8'	2	3.8/4.0				
6							
7					6.0 ft bgs - Fine to medium Sand (SP), light brown, wet, micaceous, trace 0.25" to 0.5" subrounded gravel.	Groundwater @ 6.0 ft bgs	1.1 18
8							4.3 14
9	8'-12'	3	3.5/4.0				
10							
11							
12							
13	12'-16'	4	2.3/4.0				1.1 1.9 2.2
14							1.2
15							
16							
17	16'-20'	5	3.0/4.0				
18							
19							0.9
20					19.0 ft bgs - fine to coarse sand, light-dark brown, wet, 0.125" to 1" subrounded gravel.		0.8
21	20'-24'	6	3.0/4.0				
22					21.5 ft bgs - Silty fine Sand (SM), light gray, wet, micaceous.		5.2 24.8
23							22
24							
25	24'-28'	7	3.0/4.0		24.0 ft bgs - gray/brown.	Strong solvent odor.	282
26							798
27					26.7 ft bgs - Clay Till (CL), gray, hard, with limestone pebbles.		398 447
28							
29					**EOB @27.0 ft bgs**		
30							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-207	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E of SO-200
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.0 ft bgs START: 11/29/2006 FINISH: 11/29/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.1
1	0'-4'	1	2.8/4.0		reddish brown, dry, hard, fine to coarse sand, subangular to subrounded 0.25" to 1" gravel.		1.2
2					1.25 ft bgs - Fine Sand (SP), light gray/brown, moist, firm, micaceous, 0.125" to 0.5" subrounded gravel.		1.5
3					2.5 ft bgs - 4" layer of fine to coarse sand with 0.25" to 1" rounded gravel, light-dark brown, wet firm.		0.9
4							1.3
5	4'-8'	2	3.2/4.0		5.0 ft bgs - light brown, wet.	Groundwater @ 5.0 ft bgs	1.2
6							1.1
7							5
8							1.1 3.6
9	8'-12'	3	3.7/4.0				18.9
10							4.6
11							6.1
12							2.1
13	12'-16'	4	3.4/4.0				4.6 4.3
14							1.1
15							1.1 1
16							1.8
17	16'-20'	5	3.5/4.0		17.0 ft bgs - fine to coarse sand, light gray.		2
18							1.9 1.5
19					18.75 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		1.4
20							3.8
21	20'-24'	6	3.5/4.0				3.3
22							3
23							1.3
24					24.0 ft bgs gray, small (0.5-1 cm) shells present		1 1.1
25	24'-28'	7	2.5/4.0		25.4 ft bgs - angular limestone pebbles. 25.5 ft bgs - Clay Till (CL), gray, hard.		0.7 0.6
26							
27							
28					**EOB @26.5 ft bgs**		
29							
30							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-208 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E of SO-200
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.5 ft bgs START: 11/29/2006 FINISH: 11/30/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0
1	0'-4'	1	2.5/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.125" to 1" gravel.		0
2					1.0 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, micaceous, trace 0.25" to 0.5" subrounded		0
3					gravel.		0
4							
					4.3 ft bgs 3" layer of 0.125" to 0.25 " rounded gravel.		0
5	4'-8'	2	3.4/4				
					5.25 ft bgs - 2" layer of coarse sand.		2.5
6					5.5 ft bgs - wet.	Groundwater @ 5.5 ft bgs	0.1
							1.5
7							
					7.0 ft bgs - 3" layer of 1 to 2 mm laminations in fine		2
8					sand, alternating black and light brown.		0
							1.5
9	8'-12'	3	3.8/4				
							4
10							3.7
							13
11							
							6.1
12							
							3.2
13	12'-16'	4	2.5/4				0.5
							0.3
14							0.5
					14.0 ft bgs - 1" layer of clayey silt, dark gray, wet, soft bgs		0.7
15							
16							
							0.2
17	16'-20'	5	2.4/4				
							0.1
18							
					18.25 ft bgs - 3" layer of organic soil (possibly peat),		0.3
19					black, wood fibers and grasses.		0.2
					18.5 ft bgs - Silty fine Sand (SM), light gray, wet,		
20					firm to hard, micaceous.		
							0.2
21	20'-24'	6	2.4/4				0.1
							0.1
22							
							0.2
23							0.1
24							
					24.0 ft bgs - brown/gray.	Moderate solvent odor.	2.1
25	24'-28'	7	2.3/4				
							7.8
26					25.9 ft bgs - angular limestone fragments (0.75" to 1.5").		
					26.0 ft bgs - Clay Till (CL), gray, hard, with 0.25" to		21.1
27					1" gravel.		3.3
28							
					EOB @26.3 ft bgs		
29							
30							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-209	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 14' N of SO-200
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 11/30/2006 FINISH: 11/30/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0
1	0'-4'	1	3.0/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.125" to 0.5" gravel.		0
2					1.25 ft bgs - Fine to medium Sand (SP), light brown,		0
					moist, firm, micaceous, trace 0.25" to 1" subrounded		0.5
3					gravel.		
							0.8
4							
					4.0 ft bgs - wet.	Groundwater @ 4.0 ft bgs	2.3
5	4'-8'	2	3.8/4				
							0.4
6							
							3.2
7							
							0.8
8					7.5 ft bgs - 3" layer of 1 to 2 mm laminations in fine		70.7
					sand, alternating black and light brown.		34
9	8'-12'	3	2.5/4				25.5
							27.3
10							
							66
11							
							78.1
12							76.5
							130
13	12'-16'	4	2.5/4				
							60.6
14							
							29.2
15							
16							5.5
					16.75 ft bgs - 4" layer of gravelly sand, fine to coarse		25.1
17	16'-20'	5	2.5/4		sand, 0.125" to 0.25" rounded gravel, dark gray and		4.3
					light brown.		11.7
18							
							2.1
19							
							0.9
20							
					20.0 ft bgs - Silty fine Sand (SM), light gray, firm to		9.2
21	20'-24'	6	1.8/4		hard, wet.		
							0.5
22							
							1.1
23							
24							
					24.0 ft bgs - gray-brown.	Strong solvent odor.	7.1
25	24'-28'	7	2.0/4		25.4 ft bgs - angular gravel.		19.1
					25.5 ft bgs - Clay Till (CL), gray, hard, with 0.125" to		725
26					1" gravel.		211
27							
28							
					EOB @26 ft bgs		
29							
30							

CH2MHILL	**PROJECT NUMBER** 348136.TT.01	**BORING NUMBER** SO-210 — SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 25' N of SO-200
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/4/2006 FINISH: 12/5/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0
1	0'-4'	1	3.0/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.125" to 1" gravel.		0
2					1.5 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, micaceous, trace 0.25" to 0.5" subrounded		0
3					gravel.		0.9
							0.4
4							
					4.0 ft bgs - wet.	Groundwater @ 4.0 ft bgs	1.1
5	4'-8'	2	3.8/4				
							3.9
6							2
							26.7
7							
					7.0 ft bgs - 4" layer of 0.25" to 1" rounded gravel,		39
8					some coarse sand.		20.7
							48.3
9	8'-12'	3	2.5/4				33.6
							69.7
10							
							110
11							
							39.4
12							
							44.3
13	12'-16'	4	2.3/4				57
							243
14							
							142
15							
16							
					16.0 ft bgs - sand size increasing (fine to coarse sand).		110
17	16'-20'	5	2.4/4				4.6
					17.0 ft bgs - fine sand.		45.5
18							
							22.2
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), light gray, wet,		0.8
21	20'-24'	6	2.1/4		hard.		2.9
							22.2
22							
							28.7
23							
24							
					24.0 ft bgs - brownish gray, 0.25" to 1" rounded gravel,		54
25	24'-28'	7	2.0/4				12
					25.0 ft bgs - Clay Till (CL), gray, hard.		8
26							
27							
28							
					EOB @26.0 ft bgs		
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-211	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 35' NW of SO-200
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 6.0 ft bgs START: 12/4/2006 FINISH: 12/5/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.5
1	0'-4'	1	3.6/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		0.6
2					1.5 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, micaceous, trace 0.25" to 1" subrounded		0.5
3					gravel.		
							0.5
4							
5	4'-8'	2	3.2/4				
6							
					6.0 ft bgs - wet.	Groundwater @ 6.0 ft bgs	4.5
7							7
8							5.1
							68.9
9	8'-12'	3	3.0/4				
							154
10							
							238
11							
							127
12							
13	12'-16'	4	2.3/4				
14							
15							
16							
							68.6
17	16'-20'	5	2.5/4				
					17.0 ft bgs - trace silt, increasing silt with depth.		222
18							126
19							
20							
21	20'-24'	6	2.2/4				
22							
23							
24							
					24.0 ft bgs - Silty fine Sand (SM), brownish-gray, wet, hard.	Strong solvent odor.	179
25	24'-28'	7	1.9/4				
					25.5 ft bgs - angular gravel with course sand.		208
26					25.6 ft bgs - Clay Till (CL), gray, hard.		1,078
27							
28							
					EOB @25.9 ft bgs		
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-212b	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 23' NW of SO-211
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/5/2006 FINISH: 12/5/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.5
1	0'-4'	1	2.3/4		reddish brown, dry, hard, fine to coarse sand,		0.3
					subangular to subrounded 0.25" to 1" gravel.		0.2
2					1.5 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, micaceous, trace 0.25" to 0.5" subrounded		0.3
3					gravel.		
4							
					4.0 ft bgs - dark brown, wet.	Groundwater @ 4.0 ft bgs	0.3
5	4'-8'	2	3.2/4		4.5 ft bgs - 6" layer of gravelly sand, 0.25" to 0.5" subrounded		
					gravel, fine to coarse sand.		0.3
6					5.0 ft bgs - light brown.		0.6
							0.3
7							
							0.3
8							0.4
							5.4
9	8'-12'	3	2.5/4				1.7
							12.3
10							
							57.4
11							
							20.9
12							
							67
13	12'-16'	4	2.4/4				24
							22.3
14							
							90.9
15							55.5
16							
							453
17	16'-20'	5	2.2/4				122
					17.0 ft bgs - no gravel.		85/523
18							
							128
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), dark gray, wet, hard.		166
21	20'-24'	6	2.2/4				198
							60/424
22							
							815
23							
24							
					24.0 ft bgs - grayish-brown, damp.		263
25	24'-28'	7	1.8/4				
					25.5 ft bgs - 2" layer of fractured rock, black, hard.		168
26						0.5" steel splinter found in	212
						bottom inch of core.	
27							
28							
					EOB @25.8 ft bgs		
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-213	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 25' S of SO-204 (8' E of building wall)
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/5/2006 FINISH: 12/6/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	2.7/4				
2							
3							
4							
5	4'-8'	2	3.8/4				
6							
7							
8							
9	8'-12'	3	2.5/4				
10							
11							
12							
13	12'-16'	4	2.3/4				
14							
15							
16							1.3
17	16'-20'	5	2.7/4				
18							
19							
20							
21	20'-24'	6	2.5/4				
22							
23							
24					24.0 ft bgs - Silty fine Sand (SM), brown/gray, damp, grain size decreases with depth.		60
25	24'-28'	7	2.0/4		25.25 ft bgs - angular limestone gravel.		133
26					25.5 ft bgs - Clay Till (CL), gray, hard.	Very strong solvent odor.	9,999
27							
28					**EOB @26.0 ft bgs**		
29							
30							

CH2MHILL	PROJECT NUMBER	BORING NUMBER	
	348136.TT.01	SO-214	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' S of SO-213
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.5 ft bgs START: 12/6/2006 FINISH: 12/6/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.6
1	0'-4'	1	2.3/4		reddish brown, dry, hard, fine to coarse sand,		0.3
					subangular to subrounded 0.25" to 1" gravel.		0.3
2					1.25 ft bgs - Fine to medium Sand (SP), black/brown,		
					moist, firm, micaceous, trace 0.25" to 1" subrounded gravel.		0.4
3							
4							
							0.4
5	4'-8'	2	3.4/4				
							0.4
6					5.5 ft bgs - black/gray, wet.	Groundwater @ 5.5 ft bgs	0.4
					6.0 ft bgs - 2" organic soil layer (possibly peat),		0.7
7					6.1 ft bgs - gray.		
					6.25 ft bgs - light brown.		13.4
8							5.4
							8.3
9	8'-12'	3	2.5/4				6.3
							7.5
10							
							8.8
11							
							15.2
12							
							30.9
13	12'-16'	4	2.5/4				20.7
							36.6
14							
							6.1
15							4
16							
							3.1
17	16'-20'	5	2.3/4				3.6
							4.4
18							
					18 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		6.3
19							1.1
20							
							55.1
21	20'-24'	6	2.0/4				
							98.1
22							44.9
23							
24							
					24.0 ft bgs - brown/gray.	Strong solvent odor.	207
25	24'-28'	7	2.5/4				
							740
26					26.0 ft bgs - coarse sand and angular gravel, black/brown.		717
					26.2 ft bgs - Clay Till (CL), gray, hard.		
27							
28							
					EOB @26.5 ft bgs		
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-215	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' S of SO-214
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/6/2006 FINISH: 12/6/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. PID Reading (ppm)
1	0'-4'	1	2.0/4			
2						
3						
4						
5	4'-8'	2	2.8/4			
6						
7						
8						
9	8'-12'	3	2.5/4			
10						
11						
12						
13	12'-16'	4	2.5/4			
14						
15						
16						
17	16'-20'	5	2.3/4			
18						
19						
20						
21	20'-24'	6	2.7/4			
22						
23						
24					24.0 ft bgs - Silty fine Sand (SM), brown/gray, damp.	Very strong solvent odor. Oil sheen obsderved on outside of core.
25	24'-28'	7	3.0/4			9999
26					26.5 ft bgs - Clay Till (CL), gray, hard. Top 6" of till contains a higher percentage of gravel.	4519 PID in breathing space (1 m from core) ~20 ppm
27						
28					**EOB @27.0 ft bgs**	
29						
30						

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-216	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 25' S of SO-215

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: 4.0 ft bgs START: 12/6/2006 FINISH: 12/6/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		6.8
1	0'-4'	1	2.9/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		1.9
2					1.25 ft bgs - 2" layer of organic soil, dry, hard, 0.25" rounded		0.6
					gravel.		1.9
3					1.3 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, micaceous, some 0.25" to 0.5" subrounded gravel.		
4							
					4.0 ft bgs - wet.	Groundwater @ 4.0 ft bgs	1.3
5	4'-8'	2	3.5/4				
					5.0 ft bgs - fine to coarse sand, gray/brown, trace gravel.		1.1
6							1.4
					6.25 ft bgs - fine to medium sand.		4.1
7							
							1.1
8							2.1
							26.1
9	8'-12'	3	2.4/5				18.9
							20.2
10							
							18.1
11							3.8
12							
							2.2
13	12'-16'	4	2.5/4				0.6
							1.9
14							21.6
					14.0 ft bgs - trace 0.25" to 1 " subrounded gravel.		18.9
15							4.4
16							
							1.4
17	16'-20'	5	2.5/4				
							1.2
18							
					18.0 ft bgs - 1" layer of clay, dark gray, soft bgs, wet.		2
19					18.1 ft bgs - dark gray.		1.2
20							
					20.0 ft bgs - Silty fine Sand (SM), dark gray, wet, hard.		2.5
21	20'-24'	6	2.5/4				
							143
22							
							155
23							
							59.4
24							
					24.0 ft bgs - brown/gray.		102
25	24'-28'	7	3.5/5		24.5 ft bgs - Clay Till (CL) and gravel (0.25" - 1"), gray, hard	No odor.	16.1
26							
27							
28							
					EOB @27.5 ft bgs		
29							
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-217	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E of SO-215
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/8/2006 FINISH: 12/8/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.6
1	0'-4'	1	2.7/4		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		0.5
2					1.5 ft bgs - Fine to medium Sand (SP), dark gray/brown,		
					moist, firm, micaceous, some 0.25" to 1" subrounded gravel.		0.5
3					2.6 ft bgs - light brown.		0.4
4							
					4.0 ft bgs - dark gray/brown, wet.	Groundwater @ 4.0 ft bgs	0.5
5	4'-8'	2	3.2/4				
							0.4
6							
					6.0 ft bgs - 3" layer of organic soil, degraded and matted grass,		0.4
7					black, wet.		
					6.25 ft bgs - tracce 0.25" to 0.5" subrounded gravel.		1.9
8							
							1.6
9	8'-12'	3	1.8/4				
							3.9
10							
							3.5
11							
12							
							4.2
13	12'-16'	4	2.4/4				5.2
							2.2
14							
							1.8
15							1
16							
							0.7
17	16'-20'	5	2.3/4			Geoprobe operator reports	
						odor around boring.	0.7
18						PID reading 0.3 ppm in	
						breathing area.	0.4
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		2
21	20'-24'	6	2.5/4				
							7
22							
							39
23							150
24							
					24.0 ft bgs - grayish brown.		903
25	24'-28'	7	2.8/4		24.8 ft bgs - course angular gravel.		
					25.0 ft bgs - Clay Till (CL), gray, hard.	No odor	207
26							29
27							
28					**EOB @26.8 ft bgs**		
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-218	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' NW of SO-211

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: 5.0 ft bgs START: 12/8/2006 FINISH: 12/8/2006 LOGGER: **K. Davis / I. Mueller**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	NUMBER AND TYPE	RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.4
1	0'-4'	1	2.7/4		reddish brown, dry, hard, fine to coarse sand, subangular to subrounded 0.25" to 1" gravel.		0.3
2					1.25 ft bgs - Fine to medium Sand (SP), gray/brown, moist, firm, micaceous, some 0.25" to 0.5" subrounded gravel.		0.3
3							0.3
4							0.5
5	4'-8'	2	3.4/4		5.0 ft bgs - trace 0.25" to 1" rounded gravel, wet.	Groundwater @ 5.0 ft bgs	0.5
6							0.9
7							1.9
8							23.3
9	8'-12'	3	2.4/4				68.1
10							52.5
11							39.1
12							148
13	12'-16'	4	3.0/4				122
14							289
15							155
16							1,190
17	16'-20'	5	2.5/4		17.0 ft bgs - light brown/gray.		392
18							593
19							164
20					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		237
21	20'-24'	6	2.3/4				591
22							1,031
23							488
24					24.0 ft bgs - gray/brown, damp.	Moderate solvent odor.	410
25	24'-28'	7	2.0/4		26.0 ft bgs - Clay Till (CL), gray, hard.		725
26							847
27					**EOB @26.0 ft bgs**		
28							
29							
30							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-219	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.0 ft bgs START: 12/11/2006 FINISH: 12/11/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.5
1	0'-4'	1	3.0/4.0		reddish brown, dry, hard, fine to coarse sand, subangular to subrounded 0.25" to 1" gravel.		0.6
2					1.5 ft bgs - Fine to medium Sand (SP), light brown, moist, firm, trace 0.25" subrounded gravel.		0.6
3							0.6
4							0.5
5	4'-8'	2	3.8/4.0		5.0 ft bgs - wet.		0.5
6							0.5
7							0.9
8							0.9
9	8'-12'	3	2.75/4.0				2.1 6.4
10							3.9
11							5.6
12							0.8
13	12'-16'	4	3.0/4.0		13.0 ft bgs - dark gray.		0.7
14					14.0 ft bgs - light gray/brown.		0.7
15							2.1 1
16							
17	16'-20'	5	0/4.0				
18							
19							
20					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.	No odor.	1.1
21	20'-24'	6	2.2/4.0				3.6
22							14.6
23							
24					24.0 ft bgs - Fine Sand (SP), well-sorted, gray, wet.	No odor.	1
25	24'-28'	7	2.6/4.0		24.8 ft bgs - Sand and Gravel (SW), poorly-sorted, gray, wet, subrounded to rounded gravel.		
26					25.4 ft bgs - Clay Till (CL), gray, very stiff, some gravel decreasing with depth.	No odor.	
27					**EOB @26.6 ft bgs**		
28							
29							
30							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-220	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.0 ft bgs START: 12/11/2006 FINISH: 12/11/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.6
1	0'-4'	1	3.0/4.0		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		0.6
2					1.5 ft bgs - Fine to medium Sand (SP), light brown,	No odor.	
					moist, firm, trace 0.25" to 0.5" subrounded gravel.		0.7
3							
							0.4
4							
							0.5
5	4'-8'	2	3.2/4.0				
					5.0 ft bgs - wet.	Groundwater @ 5.0 ft bgs	0.5
6							
					6.0 ft bgs - 3" layer of fine to coarse sand with 0.125" rounded gravel.	No odor.	0.8
7							11.3
							21.6
8							
							14.9
9	8'-12'	3	2.5/4.0			No odor.	2.3
							30.2
10							
							35.5
11							15.8
12							
							5.3
13	12'-16'	4	2.0/4.0			No odor.	3
							2.4
14							
							2.7
15							
16							
							3.6
17	16'-20'	5	3.0/4.0				2.7
							3
18						Very slight odor.	3.5
							2.1
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		120
21	20'-24'	6	2.0/4.0				
							24.5
22						Slight odor.	71.4
							40.5
23							
24							
					24.0 ft bgs - Fine Sand (SP), well-sorted, tan/brown, wet.	Odor present.	1,212
25	24'-28'	7	2.2/4.0				
					25.0 ft bgs - Sand and Gravel (SW), poorly-sorted, wet.		1,771
26					25.65 ft bgs - Clay Till (CL), gray, very stiff, trace gravel.	No odor.	3
27					**EOB @26.2 ft bgs**		
28							
29							
30							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-221	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.0 ft bgs START: 12/12/2006 FINISH: 12/12/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.1
1	0'-4'	1	2.6/4.0		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		0.3
2					1.0 ft bgs - Fine to medium Sand (SP), dark brown/gray,		
					moist, firm, trace 0.25" to 1" subrounded gravel.		0.1
3					1.75 ft bgs - light brown.		0.1
4							
							0.3
5	4'-8'	2	4.0/4.0				
					5.0 ft bgs - wet.		0.1
6							
							0.3/0.1
7							
							3.4
8							5.5
							1.3/133
9	8'-12'	3	2.4/4.0				
							87.4
10							
							27.4
11							5.6/18.2
12							
							5.4
13	12'-16'	4	2.25/4.0				
							1.3
14							
					14.0 ft bgs - trace 0.125" to 1" subrounded gravel.		0.6/0.9
15							
16							
							2.7
17	16'-20'	5	2.25/4.0				
							3.1
18							4
							3.8
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		36.9
21	20'-24'	6	2.5/4.0				
							227
22							
							137
23						Odor present.	163
24							
					24.0 ft bgs - Fine Sand (SP), well-sorted, gray, wet.	Odor present.	2,206
25	24'-28'	7	2.2/4.0				519
					25.6 ft bgs - Sand and Gravel (SW).		
26					25.9 ft bgs - Clay Till (CL).		243
27					**EOB @26.2 ft bgs**		
28							
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-222	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.8 ft bgs START: 12/12/2006 FINISH: 12/12/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.3
1	0'-4'	1	2.7/4.0		reddish brown, dry, hard, fine to coarse sand, subangular to subrounded 0.25" to 1" gravel.		0.5
2					1.25 ft bgs - Fine to medium Sand (SP), dark brown/gray, moist, firm, trace 0.25" to 1" subrounded gravel.		0.6
3					2.0 ft bgs - light brown.		0.5/0
4							2.6
5	4'-8'	2	4.0/4.0				5
							1.9
6					5.8 ft bgs - fine to coarse sand, wet.		3.7
7					7.0 ft bgs - fine - medium sand.		10.5
8							23.9
							45.7/53.2
9	8'-12'	3	2.7/4.0				48.2
10							62.2
11							49
12							0.5
13	12'-16'	4	3.25/4.0				0.8
14							0.5
15							0.3
16							1.2
							1.1
17	16'-20'	5	2.5/4.0				1.1
18							1
19							1.2
							0.4
20					20.0 ft bgs - Silty fine Sand (SM), light gray, wet, hard.		0.9
21	20'-24'	6	2.7/4.0				0.7
22							1.3
23							5.7
							2.8
24					24.0 ft bgs - Fine Sand (SP), well-sorted, gray, wet.	No odor.	
25	24'-28'	7	2.8/4.0		24.8 ft bgs - Sand and Gravel (SW).		
					25.4 ft bgs - Clay Till (CL), gray, very stiff.		18.7
26						No odor.	
27							
28					**EOB @26.8 ft bgs**		
29							
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-223	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/13/2006 FINISH: 12/13/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Silty Sandy Gravel Fill with some Clay (GM),		0.3
1	0'-4'	1	2.7/4.0		reddish brown, dry, hard, fine to coarse sand,		0
					subangular to subrounded 0.25" to 1" gravel.		0.3
2					1.0 ft bgs - Fine to medium Sand (SP), light brown,		
					moist, firm, trace 0.25" subrounded gravel.		0.3
3							1
4							
					4.0 ft bgs - wet.	Groundwater @ 4.0 ft bgs	1.5
5	4'-8'	2	4.0/4.0				0
							0.8
6							
							1.1
7							
							1.3
8							0.6
							0.8
9	8'-12'	3	2.75/4.0				0.6
							4.9
10							
							15.5
11							0.9
12							
							0.5
13	12'-16'	4	2.7/4.0				0.5
					13.0 ft bgs - grain size decreasing with depth.		0.6
14							
							0.7
15							1.9
16							
							0.2
17	16'-20'	5	2.25/4.0				
					17.0 ft bgs - trace silt, light gray/brown.		0.2
18							1.4
							1.5
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), gray, wet, hard.		2.8
21	20'-24'	6	2.25/4.0				
							0.8
22							48
							12.4
23							
24							
					24.0 ft bgs - Fine Sand (SP), well-sorted, wet.		462
25	24'-28'	7	2.3/4.0		24.5 ft bgs - Sand and Gravel (SW), poorly sorted, wet.		
					24.8 ft bgs - Clay Till (CL), some sand and gravel, gray,		
26					very stiff.		42.3
27					**EOB @26.3 ft bgs**		
28							
29							
30							

CH2MHILL	PROJECT NUMBER	BORING NUMBER	
	348136.TT.01	SO-224	SHEET 1 OF 1

SOIL BORING LOG

PROJECT:	**OMC Plant 2**	LOCATION:	
ELEVATION:		DRILLING CONTRACTOR:	**IPS**
DRILLING METHOD AND EQUIPMENT USED:	**Geoprobe**		
WATER LEVELS: 6.0 ft bgs	START: 12/13/2006	FINISH: 12/13/2006	LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					<u>**Silty Sandy Gravel Fill with some Clay (GM)**</u>,		0.3
1	0'-4'	1	2.75/4.0		reddish brown, dry, hard, fine to coarse sand,		
					subangular to subrounded 0.25" to 1" gravel.		0.2
2					1.0 ft bgs - Fine to medium Sand (SP), dark brown,		0.1
					moist, firm, trace 0.25" to 1" subrounded gravel.		0.3
3							0.3
4							
							32.9
5	4'-8'	2	4.0/4.0				6.2
							8.4
6							3.4
					6.0 ft bgs - 6" layer of fine to coarse sand with 0.125" to 0.5"	Groundwater @ 6.0 ft bgs	13.8
7					subrounded gravel, wet.		
					7.0 ft bgs - light brown.		0.2
8							
							0.3
9	8'-12'	3	2.8/4.0				78.1
							222
10						Slight sweet odor.	170
							114
11							
							150
12							
							612
13	12'-16'	4	2.5/4.0				
							297
14							
							181
15							
							8.3
16							
							1,031
17	16'-20'	5	2.1/4.0				
					17.0 ft bgs - trace silt, grain size decreasing with depth.		1,421
18							
							938
19							
						Odor present.	3,479
20							
					20.0 ft bgs - Silty fine Sand (SM), gray, wet, hard.	PID reading 0.3 ppm in	4,329
21	20'-24'	6	2.3/4.0			breathing area.	
						LEL 0%.	782
22							
							484
23						Stong odor and sheen.	9,999
24							
					24.0 ft bgs - Fine Sand (SP), gray, well-sorted, wet.	Strong odor.	9,015
25	24'-28'	7	1.9/4.0		25.35 ft bgs - Sand and Gravel (SW).		
					25.4 ft bgs - Clay Till (CL), gray, very stiff.	Strong odor, no sheen.	604
26							
27					**EOB @25.9 ft bgs**		
28							
29							
30							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-225 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2**		LOCATION:	
ELEVATION:		DRILLING CONTRACTOR: **IPS**	
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**			
WATER LEVELS: 2.3 ft bgs	START: 12/13/2006	FINISH: 12/13/2006	LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					<u>Asphalt and Sand and Gravel</u>, gray, dry.		
1	0'-4'	1	2.6/4.0		0.8 ft bgs - Coarse Sand and Gravel (SW), red/brown, moist, poorly sorted.		0
2					1.6 ft bgs - 8" layer of medium sand, trace gravel, gray/brown, moist, moderately sorted.		0
3					2.3 ft bgs - brown, wet.	Groundwater @ 2.3 ft bgs	
4							0.1
5	4'-8'	2	4.0/4.0				1.1
6					6.0 ft bgs - Medium Sand with Gravel (SP), brown, wet.	Slight odor.	3.6
7					6.75 ft bgs - trace gravel.		20
8							22
9	8'-12'	3	3.1/4.0		8.75 ft bgs - Medium to coarse Sand with Gravel (SW), brown, wet, poorly sorted.	Slight odor.	26.1
10					9.5 ft bgs - fine to medium sand, trace gravel.	Slight odor.	42.2
11					10.5 ft bgs - medium to coarse sand, some gravel.	Slight odor.	95.1
12					12.0 ft bgs - Fine Sand (SP), brown, wet, well sorted, trace coarse sand and wood fragments.		93.9
13	12'-16'	4	2.6/4.0				100
14					14.1 ft bgs - 3" layer of coarse sand with trace gravel, gray, wet.		367
15							
16					16.9 ft bgs - 6" layer of medium to coarse sand, gray/brown.		1,095
17	16'-20'	5	2.6/4.0				858
18							1,431
19							3,143
20							
21	20'-24'	6	0.0/4.0				
22							
23							
24							810
25	24'-28'	7	2.2/4.0		25.3 ft bgs - Silty Clay (CL), gray, soft bgs	Strong odor. Slight sheen.	4,952
26					25.5 ft bgs - Coarse sand with some fines (SM), gray, wet, poorly sorted.		9,999 1,325
27							
28					28.0 ft bgs - medium to coarse sand.	Strong odor.	9,999
29	28'-32'	8	3.5/4.0		28.7 ft bgs - Silty Clay Till (CL), gravy very stiff, trace gravel.		9,999
30					29.5 ft bgs - stiff.	Sheen. Last foot of plastic liner was stained pale green.	9,999
31							9,999
32					**EOB @31.5 ft bgs**		

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-226	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/13/2006 FINISH: 12/14/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Asphalt, gray, dry.	Odor present.	
1	0'-4'	1	2.6/4.0		0.9 ft bgs - Sand and Gravel (SW), red/brown, moist, poorly sorted.		12.3 47.9
2					1.7 ft bgs - Medium Sand (SP), brown, moist, trace gravel. 2.0 ft bgs - dark brown.	Slight odor.	27.6
3							
4							
5	4'-8'	2	4.0/4.0		4.0 ft bgs - Medium to coarse Sand and Gravel (SW), brown, wet, poorly sorted.	Odor present.	28.1 21.2
6							15.9
7					7.0 ft bgs - Fine to medium Sand (SP), brown, wet, well sorted.		7.7
8							51.7
9	8'-12'	3	2.5/4.0		8.75 ft bgs - Medium to coarse Sand and Gravel (SW), brown, wet.		65.1
10							94.8
11							
12							
13	12'-16'	4	2.8/4.0		12.0 ft bgs - Fine to medium Sand (SP), brown, wet, well sorted. 12.8 ft bgs - gray.	Odor present.	386 286
14					13.0 ft bgs - medium sand, brown. 13.5 ft bgs - interbedded layers of fine to medium sand and coarse sand with trace gravel.	Slight odor. Odor present.	448
15							
16							
17	16'-20'	5	2.25/4.0		16.0 ft bgs - fine to medium sand. 16.5 ft bgs - 4" layer of medium to coarse sand, brown, wet, trace gravel.	Slight odor.	418 656
18					16.8 ft bgs - fine sand.	Odor present.	1,547
19							
20							
21	20'-24'	6	2.2/4.0		20.0 ft bgs - fine to medium sand, gray and dark gray (salt a pepper-like appearance). 20.5 ft bgs - fine sand with some silt.	Slight odor. Slight sheen.	9,999 3,719
22							4,661
23							
24							
25	24'-28'	7	2.2/4.0		24.8 ft bgs - Silt (ML), gray, moist. 25.1 ft bgs - some fine sand. 25.5 ft bgs - Clay with coarse Sand (CL), moist, poorly sorted, angular sand		1,738/2,517
26					25.95 ft bgs - Clay till (CL), gray, very stiff, trace very coarse sand and gravel	Odor present.	625 33.4
27					**EOB @ 26.2 ft bgs**		
28							
29							
30							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-227 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 2.0 ft bgs START: 12/14/2006 FINISH: 12/14/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Asphalt.	Odor present.	
1	0'-4'	1	3.7/4.0		0.75 ft bgs - Sand and Gravel Fill with some fines (GW), red/brown, poorly sorted.		14.1
2					1.4 ft bgs - Fine Sand (SP), brown, moist, well sorted. 2.0 ft bgs - Medium to coarse Sand with gravel (SW), brown, wet.	Groundwater @ 2.0 ft bgs	2.8
3							
4					4.0 ft bgs - alternating sequence of medium sand with gravel and coarse sand with gravel.	Odor present.	2.1
5	4'-8'	2	4.0/4.0				2.3
6							6.3
7					7.0 ft bgs - medium sand, trace gravel.		45.1
8					8.75 ft bgs - medium to coarse sand with gravel.		27.7
9	8'-12'	3	2.8/4.0		9.4 ft bgs - fine to medium sand, moderately sorted, fine lenses of coarse sediment.		206
10							196
11							86
12					12.0 ft bgs - alternating layers of fine sand and medium to coarse sand with gravel, appears to fine upward, coarse layers have speckled look.		276
13	12'-16'	4	2.5/4.0				324
14							407
15							
16					16.0 ft bgs - Fine Sand (SP), brown, wet.		341
17	16'-20'	5	2.8/4.0		16.9 ft bgs - 4" layer of coarse sand, gray/brown, wet, moder to well sorted.	Odor present.	540
18					17.2 ft bgs - fine sand with very fine lenses of speckled medium sand.		192
19							278
20					20.0 ft bgs - Fine Sand (SP) grading to Sandy Silt (ML), gray, wet, very well sorted, silt retaining water.	Slight odor.	236
21	20'-24'	6	2.75/4.0				171
22							86.1
23							227
24					24.0 ft bgs - Fine Sand (SP), gray, wet, very well sorted.	Slight odor.	
25	24'-28'	7	2.5/4.0		25.5 ft bgs - 5" layer of sand and subangular gravel. 25.9 ft bgs - Clay Till (CL), gray, stiff, trace coarse sand.		
26							
27					**EOB @ 26.5 ft bgs**		8
28							
29							
30							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-228	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E of SO-225
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/14/2006 FINISH: 12/14/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Asphalt.	Odor present.	2.2
1	0'-4'	1	2.0/4.0		0.3 ft bgs - Gravel and Sand Fill (GW), red/brown.		
					0.5 ft bgs - 2" layer of limestone.		1.5
2					0.8 ft bgs - Fine to medium Sand (SP), gray/brown, moist,		
					trace gravel.		2.2
3							
4							
					4.0 ft bgs - dark brown, wet.	Odor present.	1
5	4'-8'	2	4.0/4.0				
					5.0 ft bgs - Sand and Gravel (SW), brown, wet, poorly		1.1
6					sorted, well rounded.		
							1.4
7					6.4 ft bgs - medium sand with trace gravel.		
							2.5
8							
							8.4
9	8'-12'	3	2.5/4.0				
							122
10					9.5 ft bgs - Sand and Gravel (SW), brown, wet, poorly		
					sorted.		153
11					9.8 ft bgs - Fine to medium sand (SP), brown, wet, well	Slight odor.	
					sorted.		
12							
					12.0 ft bgs - trace gravel.	Odor present.	335
13	12'-16'	4	2.5/4.0				
							412
14							
							486
15							
16							
					16.25 ft bgs - 4" layer of coarse sand with trace gravel,		588
17	16'-20'	5	2.25/4.0		brown/gray, wet, moderately sorted.		
					16.6 ft bgs - gray.		1,274
18							
							1,642
19							
20							
					20.0 ft bgs - Fine Sand with some Silt (SP), gray, wet.	Slight odor.	883
21	20'-24'	6	2.2/4.0				
							1,454
22							
							3.536
23							
24							
25	24'-28'	7	3.0/4.0				2,761
					25.3 ft bgs - 0.5" layer of clayey silt.		
26					26.0 ft bgs - Sand and Gravel (SW), gray, moist,		1,441
					subrounded to subangular grains.		436
27					26.4 ft bgs - Clay Till (CL), gray, trace coasre sand, dry-moist, stiff		28.2
28					**EOB @ 27.0 ft bgs**		
29							
30							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-229	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E of SO-226
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 4.0 ft bgs START: 12/14/2006 FINISH: 12/15/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Asphalt.	Odor present.	
1	0'-4'	1	3.4/4.0		0.6 ft bgs - Gravel and Sand Fill (GW), red/brown.		
					1.2 ft bgs - Fine to medium Sand (SP), gray/brown, moist, trace gravel.		2.5
2					2.0 ft bgs - dark brown.		2.1
3					2.4 ft bgs - Medium to coarse Sand and Gravel (SW), brown, very moist.		1.8
4					4.0 ft bgs - medium sand, trace gravel, brown/gray, wet.	Odor present.	5.7
5	4'-8'	2	4.0/4.0		5.0 ft bgs - sand and gravel, brown, poorly sorted.		1.8
6							1.9
7					6.5 ft bgs - medium to coarse sand and gravel, moderately sorted.		3.5
8					8.0 ft bgs - fine to medium sand, well sorted, trace rounded gravel.		12.4/56.6
9	8'-12'	3	2.0/4.0				164
10							289
11							
12					12.0 ft bgs - trace coarse sand.		481
13	12'-16'	4	2.3/4.0			Slight odor.	345
14							438
15							
16					16.0 ft bgs - Fine Sand (SP), gray/brown, wet, trace coarse sand.		1995
17	16'-20'	5	2.5/4.0		16.6 ft bgs - 2" layer of medium to coarse sand with trace gravel, gray/brown, wet.		351
18							431
19							
20					20.0 ft bgs - fine sand with some silt, gray.	Slight odor.	88.1
21	20'-24'	6	2.1/4.0				56.2
22							306
23							
24					24.0 ft bgs - some silty clay stringers.	Slight odor.	386
25	24'-28'	7	3.0/4.0				304
26					26.0 ft bgs - Clay Till with Sand and Gravel (CL), gray, stiff, dry-moist, subangular grains.		10.3
27							0.8
28							
29					**EOB @ 28.0 ft bgs**		
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-230	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.3 ft bgs START: 12/15/2006 FINISH: 12/15/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Gravel and Sand Fill (GW), red/brown, moist, poorly	Odor present.	
1	0'-4'	1	1.75/4.0		sorted.		
							0
2							
3							
4							
					4.4 ft bgs - Fine Sand (SP), dark gray, moist, some gravel,	Odor present.	28.4
5	4'-8'	2	2.0/4.0		moderately sorted.		
							15.2
6							
					5.3 ft bgs - Medium to coarse Sand (SW), some gravel,	Groundwater @ 5.3 ft bgs	11.5
7					brown, wet, poor to moderately sorted.		
8							
					8.0 ft bgs - well rounded 1.5" gravel (granite and quartzite).		19.2
9	8'-12'	3	2.5/4.0		8.5 ft bgs - medium sand, well sorted.		
							40.4
10					9.5 ft bgs - medium to coarse sand.		
					10.2 ft bgs - sand and 1" well rounded gravel.		73.4
11							
12							
					12.0 ft bgs - medium sand, gray/brown.	Slight odor.	309
13	12'-16'	4	2.5/4.0		12.8 ft bgs - fine to coarse sand.		
					13.3 ft bgs - coarse sand and gravel.	Odor present.	699
14							
					13.6 ft bgs - Fine Sand (SP), brown, wet, well sorted.		601
15							
16							
					16 ft bgs - medium sand.	Odor present.	1,236
17	16'-20'	5	2.2/4.0		16.3 ft bgs - fine to medium sand.		
					16.6 ft bgs - 4" layer of medium to coarse sand with some gravel,		9,541
18					brown, wet.		
					17.0 ft bgs - fine sand.		1,017
19							
20							
					20.0 ft bgs - gray.	Slight odor.	9,999
21	20'-24'	6	2.0/4.0		20.5 ft bgs - 6" layer of medium to coarse sand, dark gray.	Very strong odor.	
					21.0 ft bgs -Silty fine Sand (SM), dark gray, wet.		9,999
22							
							9,999
23							
24							
					24.0 - dark gray.	Very strong odor. Sheen.	9,999
25	24'-28'	7	2.1/4.0				
							8,219
26							
							9,999
27							
28							
					28.6 ft bgs - silt with clay, soft bgs to very soft bgs, gray.	Slight odor	4,850
29	28'-32'	8	2.5/4.0		29.0 ft bgs - Clay Till (CL), some coarse sand and gravel,		
					very stiff, dry to moist.		605
30							
							12.8
31							
					EOB @ 30.5 ft bgs		
32							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-231	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 6.0 ft bgs START: 12/15/2006 FINISH: 12/15/2006 LOGGER: **E. Molander**

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	COMMENTS	
	INTERVAL (FT)	NUMBER AND TYPE	RECOVERY (FT)	6"-6"-6"-6" (N)	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	2.5/4.0		**Sand and Gravel Fill (GW)**, red/brown, moist, poorly sorted.	Odor present.	24.5
2							83.2
3							73.8
4					4.2 ft bgs - Medium Sand (SP), dark gray/brown, moist, trac coarse sand and gravel.	Odor present.	62
5	4'-8'	2	3.3/4.0		4.5 ft bgs - moist to wet, some 1" to 1.5" well rounded gravel, moderately sorted.		99
6					6.5 ft bgs - Sand and Gravel (SW), poorly sorted, brown.	Groundwater @ 6.0 ft bgs	61.3
7							67.6
8							50.5
9	8'-12'	3	2.5/4.0		8.8 ft bgs - 4" layer of fine to medium sand, brown, well sorted.		44.5
10					9.7 ft bgs - medium to coarse sand, moderate to well sorted.		106
11							
12					12.0 ft bgs - coarse sand with 0.5" gravel 12.25 ft bgs - Fine Sand (SP), brown, well sorted, trace gravel.		382
13	12'-16'	4	2.1/4.0				117
14							212
15							
16					16.0 ft bgs - 2" layer of medium to coarse sand with some 0.5" gravel		
17	16'-20'	5	2.2/4.0				1,441
18							1,360
19							960
20					20.0 ft bgs - fine sand grading to silty sand, gray/brown.	Slight odor.	408
21	20'-24'	6	2.5/4.0				567
22							1,779
23							
24					24.0 ft bgs - Silty Fine Sand (SM), gray, well sorted, wet.	Odor present.	9,999
25	24'-28'	7	2.5/4.0				9,423
26							9,999
27							
28					28.7 ft bgs - 1" layer of clayey silt, soft bgs, gray.		4,178
29	28'-32'	8	2.5/4.0		28.75 ft bgs - Clay Till (CL), gray, dry-moist, stiff, 2" layer of gravel at top of till.		1,975
30							4
31					**EOB @ 30.5 ft bgs**		
32							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-232	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: NW corner of paint-mixing room
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 7.0 ft bgs START: 12/18/2006 FINISH: 12/18/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Clayey sand (SC), gray/brown.	Odor present.	63
1	0'-4'	1	2.5/4.0		2.0 ft bgs - Medium Sand with Silt (SM), brown/yellow, some gravel.	Odor present.	
							115
2							
							120
3							
4					4.0 ft bgs - gray/brown, grain size increasing with depth.	Odor present.	145
5	4'-8'	2	2.5/4.0				
							116
6							
							16
7						Groundwater @ 7.0 ft bgs	
8					**EOB @ 7.0 ft bgs**		
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20						Slight odor.	
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-233	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION:
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 6.5 ft bgs START: 12/18/2006 FINISH: 12/18/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Sand and Gravel mix (GW), trace clay, 2" layer of coarse	Odor present.	3.2
1	0'-4'	1	2.0/4.0		limestone gravel.		
					2.0 ft bgs - Medium Silty Sand (SM), brown.		7
2							16.2
3							
4							
					4.0 ft bgs - some clay lenses present.	Odor present.	14
5	4'-8'	2	2.0/4.0				
					5.0 ft bgs - brown/yellow, trace clay and silt.		6
6							3
7						Groundwater @ 6.5 ft bgs	
8							
					8.0 ft bgs - Coarse Sand and Gravel (GW), grain size		2.2
9	8'-12'	3	1.4/4.0		decreases with depth.		1.4
					9.0 ft bgs - Medium Sand (SP), moist, brown/yellow.		2.6
10							
11							
12							
					12.0 ft bgs - 1 ft bgs layer of medium to coarse sand with 0.25" to		2.6
13	12'-16'	4	2.5/4.0		1" gravel.		
							5.4
14							
							3.1
15							
16							
					16.0 ft bgs - Medium to Coarse Sand (SW), brown/gray,		3.2
17	16'-20'	5	2.5/4.0		moist, trace silt, some subrounded to rounded 0.5" to 1" gravel.		
							9
18							
							4.5
19							
20							
					20.0 ft bgs - Silty fine Sand (SM), gray/brown, wet.	Slight odor.	2.9
21	20'-24'	6	2.5/4.0				
							0.6
22							0.5
23							
24							
					24.0 ft bgs - increasing silt.		0.9
25	24'-28'	7	2.5/4.0				
					25.0 ft bgs - decreasing silt, gray/brown.		0.5
26							0.5
27							
28							
							1.1
29	28'-30'	8	2.0/2.0				
							1.6
30							
					30.0 ft bgs - Clay Till (CL), gray, hard, angular coarse gravel.		
31							
					EOB @ 30.0 ft bgs		
32							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-234	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' North of SO-230
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: 5.0 ft bgs START: 12/18/2006 FINISH: 12/18/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	2.0/4.0		**Sand and Clay mix (SC)**, red/brown, 0.125" to 1" subrounded gravel.	Odor present.	14
2					1.5 ft bgs - Medium grained Sand (SP), brown.		29 12
3							
4							
5	4'-8'	2	2.6/4.0		4.0 ft bgs - Clay and Sand (SC), 0.5" to 1" well sorted rounded gravel, dark brown.	Odor present.	2.1 1.5
6					5.0 ft bgs - Coarse Sand (SP), some rounded 0.5" to 1" gravel, wet.	Groundwater @ 5.0 ft bgs	7
7							
8							
9	8'-12'	3	2.5/4.0		8.0 ft bgs - medium sand, brown/yellow.		23
10							29 322
11							
12							
13	12'-16'	4	3.0/4.0		12.0 ft bgs - 3" coarse sand lense.		3,212
14							2,517
15							2,055
16							
17	16'-20'	5	2.4/4.0		16.0 ft bgs - gray/brown, some silt and trace 0.5" to 1.25" subrounded gravel.	Very strong odor.	9,999
18							9,999
19							9,999
20							
21	20'-24'	6	2.3/4.0		20.0 ft bgs - Silty Fine Sand (SM), gray/brown, increasing silt with depth.	Slight odor.	9,999
22							798
23							2,400
24							
25	24'-28'	7	2.4/4.0			Strong odor.	957
26							2,400
27							2,517
28							
29	28'-32'	8	2.0/4.0			Acetate liner is soft bgs	1,400 850
30					29.0 ft bgs - Clay Till (CL), stiff, gray.		712
31					**EOB @ 30.0 ft bgs**		
32							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-235	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: NE corner of paint room

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: 4.0 ft bgs START: 12/19/2006 FINISH: 12/19/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Sand and Clay mix (SC), brown, dry, fine gravel.	Odor present.	
1	0'-4'	1	1.2/4.0				1
							1.1
2							
3							
4							
					4.0 ft bgs - 0.5" to 1" subrounded gravel, wet.	Odor present.	0.7
5	4'-8'	2	0.4/4.0				
6							
7							
8							
					8.0 ft bgs - Medium to Course Sand and Gravel (GW), rounded fine gravel.		22
9	8'-12'	3	2.0/4.0				
							87
10							81
11							
12							
					12.0 ft bgs - Medium Sand (SP), brown, trace 0.5" to 1" gravel.		101
13	12'-16'	4	2.5/4.0				
							62
14							
							117
15							
16							
					16.0 ft bgs - fine to medium grained sand, gray/brown, some fine gravel lenses, percentage of fine sand increases with depth.	Moderate odor.	199
17	16'-20'	5	2.5/4.0				
							152
18					18.0 ft bgs - wet.		
							162
19							
20							
					20.0 ft bgs - percentage of silt increases with depth, moist.	Slight odor.	301
21	20'-24'	6	2.5/4.0				
							189
22							
							67
23							
24							
					24.0 ft bgs - Silty Fine Sand (SM), brownish-gray, wet.		161
25	24'-28'	7	2.5/4.0				
							302
26							
							241
27							
28							
					28.3 ft bgs - Silty Clay (CL), stiff.		309
29	28'-32'	8	2.5/4.0		28.5 ft bgs - Course Sand and Gravel with Clay (GW)		
							14.1
30							
					30.5 ft bgs - Clay Till (CL), stiff, gray.		11.1
31							
					EOB @ 30.5ft bgs		
32							

CH2MHILL	PROJECT NUMBER	BORING NUMBER	
	348136.TT.01	SO-236	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 20' E of SO-224
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/19/2006 FINISH: 12/19/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Sand and Clay Mix (SC), red/brown, some gravel.	Odor present.	0
1	0'-4'	1	2.8/4.0				
							0
2					1.5 ft bgs - Medium to Course Sand (SP), brown/black, 0.25" to 1" subrounded gravel.		
3							
4							
						Odor present.	12.1
5	4'-8'	2	3.8/4.0				
							2.2
6					6.0 ft bgs - Sandy Silt (SM), black/brown, organic-rich soil.		
							2.1
7							
8							
					8.0 ft bgs - Medium Sand (SP), brown, with lenses of rounded to subrounded gravel.		25
9	8'-12'	3	3.0/4.0				
							102
10							
							59
11							
12							
					12.0 ft bgs - brown/gray, trace silt.		180
13	12'-16'	4	2.7/4.0				
							119
14					14.0 ft bgs - 3" to 4" wood fragment		
							250
15							
16							
							109
17	16'-20'	5	3.0/4.0				
					17.0 ft bgs - Coarse Sand and Gravel (SW), poorly sorted rounded to subrounded gravel.	Moderate odor.	515
18							
					18.0 ft bgs - Silty Fine Sand (SM), brown/gray.		87
19							
20							
					20.0 ft bgs - 0.25" to 0.75" rounded gravel.	Slight odor.	27
21	20'-24'	6	2.5/4.0				
							84
22							
							303
23							
24							
							589
25	24'-28'	7	3.0/4.0				
							64
26							
					26.8 ft bgs - Gravel Mix (GW), coarse angular gravel.		59
27					27.0 ft bgs - Clay Till (CL), hard, gray.		
28					**EOB @ 27.0 ft bgs**		

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-237	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' S of SO-231
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/19/2006 FINISH: 12/19/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					<u>Medium to Coarse Sand and Clay mix (SC)</u>, red/brown, trace silt and gravel.	Odor present.	52
1	0'-4'	1	2.5/4.0				23
2							
3							
4					4.0 ft bgs - Silty Fine Sand (SM), brown/black.	Odor present.	127
5	4'-8'	2	3.0/4.0		5.0 ft bgs - Medium to Course Sand (SP), 0.75" to 1.25" rounded gravel lenses.		26
6							17
7							
8							25
9	8'-12'	3	2.5/4.0		9.5 ft bgs - 0.5" to 1" rounded gravel.		19
10							39
11							
12					12.3 ft bgs - fine to medium grained sand, brown, percentage of fine sand increases with depth.		69
13	12'-16'	4	2.5/4.0				33
14							98
15							
16							246
17	16'-20'	5	2.5/4.0		16.5 ft bgs - Silty Fine Sand (SM), brown/gray, trace fine gravel.		114
18							305
19							
20					20.0 ft bgs - Fine to Medium Sand (SP), with some lenses of course sand.	Slight odor.	354
21	20'-24'	6	2.5/4.0				906
22					22.0 ft bgs - Silty Fine Sand (SM), brown/gray.		517
23							
24						Strong odor.	2511
25	24'-28'	7	2.0/4.0				714
26							1,298
27							
28					28.0 ft bgs - brown/black.		2,402
29	28'-30'	8	1.2/4.0		29.0 ft bgs - Clay Till (CL), hard, gray		797
30					**EOB @ 29.2 ft bgs**		
31							
32							

SOIL BORING LOG

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-238	SHEET 1 OF 1

PROJECT: **OMC Plant 2** LOCATION: 10' E of SO-238
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/19/2006 FINISH: 12/19/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Sand and Clay mix (SC), red/brown, weathered, some fine gravel.	Odor present.	52
1	0'-4'	1	2.5/4.0				74
2					2.0 ft bgs - Silty Fine Sand (SM), stained black.		176
3							
4						Odor present.	54
5	4'-8'	2	1.8/4.0		4.5 ft bgs - Course Gravel (GW), angular, white. 5.0 ft bgs - Medium to Course Sand (SP), brown/black.		17
6							11
7							
8					8.0 ft bgs - Fine to Medium Sand (SP), brown, trace 0.5" to 1.5" gravel.		6
9	8'-12'	3	2.0/4.0				17
10							32
11							
12					12.0 ft bgs - lenses of course sand and fine gravel. 12.8 ft bgs - percentage of fine sand increase with depth.		55
13	12'-16'	4	3.0/4.0				62
14							114
15							
16							414
17	16'-20'	5	2.5/4.0				234
18							391
19							
20					20.0 ft bgs - some silt, percentage of silt increases with dep	Slight odor.	910
21	20'-24'	6	2.5/4.0				730
22							2,600
23							
24					24.0 ft bgs - Silty Fine Sand (SM), brown/gray.	Strong odor.	3,824
25	24'-28'	7	2.0/4.0				1,389
26							2,574
27							
28						Strong odor.	3,300
29	28'-30'	8	1.5/2.0		29.5 ft bgs - Clay Till (CL), hard, gray.		3,600 215
30					**EOB @ 29.5 ft bgs**		
31							
32							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-239	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' W of SO-231, 4' W of paint room wall
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/20/2006 FINISH: 12/20/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Medium Sand and Clay mix (SC), red/brown, 0.25" to 1.5" gravel, poorly sorted.	Odor present.	
1	0'-4'	1	2.7/4.0				47
2							19
3							51
4					4.3 ft bgs - Medium Sand (SP).	Odor present.	
5	4'-8'	2	3.0/4.0				79
6					6.5 ft bgs - Course Sand and Fine Gravel (SW), average grain size increases with depth.		15
7							29
8					8.2 ft bgs - Medium to Course Sand (SP), brown, grain size decreases with depth.		
9	8'-12'	3	2.5/4.0				13
10							10
11							12
12					12.0 ft bgs - fine to medium sand, trace 0.25" to 1" gravel.		
13	12'-16'	4	2.4/4.0				30
14							29
15							92
16							
17	16'-20'	5	2.6/4.0		17.0 ft bgs - Course Sand and Fine Gravel (SW).	Slight odor.	111
18					17.5 ft bgs - Silty Fine Sand (SM), brown/gray.		205
19							102
20					20.0 ft bgs - Medium to Course Sand (SP), brown.	Slight odor.	
21	20'-24'	6	2.5/4.0		21.0 ft bgs - Silty Fine Sand (SM), brown/gray.		227
22							169
23							500
24							1,487
25	24'-28'	7	2.2/4.0			Moderate odor.	451
26							389
27							
28							389
29	28'-30'	8	1.8/2.0		29.0 ft bgs - Course Sand, Gravel and Clay mix (GW) 29.6 ft bgs - Clay Till (CL) hard, gray.		210
30							57
31					**EOB @ 29.8ft bgs**		
32							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-240	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' N of SO-239
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/20/2006 FINISH: 12/20/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
					Course Sand, Gravel and Clay mix (GW), red/brown,	Odor present.	
1	0'-4'	1	1.3/4.0		0.25" - 1" gravel.		13
2							162
3							
4					4.2 ft bgs - Medium Sand (SP), brown/black.	Odor present.	123
5	4'-8'	2	3.2/4.0		4.8 ft bgs - Coarse Sand (SW), grades into fine gravel with depth, 0.125" - 1" rounded gravel.		61
6							8
7							
8					8.0 ft bgs - Medium Sand (SP), brown.		7
9	8'-12'	3	2.0/4.0		8.5 ft bgs - Coarse Sand (SW), some fine gravel. 9.2 ft bgs - Medium Sand (SP), brown.		20
10							9
11							
12							
13	12'-16'	4	2.5/4.0				57
14					14.1 ft bgs - 3" silty clay lense, brown/black.		11
15							106
16					16.0 ft bgs - fine to mediium sand, trace silt, gray/brown.		
17	16'-20'	5	2.3/4.0		16.8 ft bgs - Fine Gravel (GM), rounded, fines into coarse sand with depth.		114
18							54
19							45
20					20.0 ft bgs - Silty Fine Sand (SM), gray/brown, medium san increases with depth.	Slight odor.	10
21	20'-24'	6	2.6/4.0				14
22							71
23							
24					24.0 ft bgs - Silty Fine Sand (SM), gray/brown.		21
25	24'-28'	7	2.3/4.0				12
26							14
27							
28					28.6 ft bgs - 9" silty clay lense, soft bgs, brown.		
29	28'-31'	8	2.2/3.0		29.5 ft bgs - Clay Till (CL), hard, gray.		87
30							22 9
31					**EOB @ 30.2 ft bgs**		
32							

	PROJECT NUMBER	BORING NUMBER	
CH2MHILL	348136.TT.01	SO-241	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 25' E of SO-233
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/20/2006 FINISH: 12/20/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
						Odor present.	17
1	0'-4'	1	2.5/4		**Sand and Clay mix (CL)** with some subangular gravel, reddish-brown		39
2							44
3							
4					4.3' rounded fine gravel	Odor present.	21
5	4'-8'	2	3.0/4		4.5' medium sand with 1-1.5" rounded gravel, black		
					5' Medium Sand (SP), brown, grain size increase with depth		12
6							10
7							
8							57
9	8'-12'	3	2.2/4				52
10							71
11							
12					12-14' fine rounded gravel lenses		173
13	12'-16'	4	2.6/4				139
14							128
15							
16							101
17	16'-20'	5	2.5/4				114
18					18' fine sand, brownish gray		67
19							
20					20' medium sand. brownish-black, coarse sand lenses	Slight odor.	198
21	20'-24'	6	2.5/4		21' Silty Fine Sand (SM), grayish-brown		8
22							7
23							
24							7
25	24'-28'	7	2.5/4				3
26							3
27							
28					28.5' soft bgs brown clay lense		7
29	28'-31'	8	2.2/3		29' Clay Till (CL), stiff, gray		3
30					**EOB @ 29.5 ft bgs**		2
31							
32							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-242	SHEET 1 OF 1

CH2MHILL

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' E od SO 241

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: START: 12/20/2006 FINISH: 12/20/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
						Odor present.	
1	0'-4'	1	2.3/4		**Sand and Clay mix (SC)**, reddish-brown		16
2					2' Medium Sand (SP), brown		39
3							23
4					4' clay lenses	Odor present.	10
5	4'-8'	2	2.5/4		5' Course Sand(SP), brown-black, some subrounded fine gravel		11
6							11
7							
8					**Medium Sand (SP)**		12
9	8'-12'	3	2.5/4		9' course sand and fine subrounded grave,l		52
10							73
11							
12							133
13	12'-16'	4	1.5/4		13' course sand and fine subrounded gravel, brownish-black		69
14							87
15							
16					16-18.5' some gravel lenses present		71
17	16'-20'	5	2.5/4				111
18							60
19							
20						Slight odor.	152
21	20'-24'	6	2.7/4		21' Fine Silty Sand (SM), brownish-gray		198
22							89
23							
24							90
25	24'-28'	7	2.1/4				76
26							108
27							
28							180
29	28'-32'	8	1.6/2		29.5' Clay Till (CL), stiff, gray		91
							104
30					**EOB @ 29.6 ft bgs**		
31							
32							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-243 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 20' S of SO-238

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: 5' START: 12/21/2006 FINISH: 12/21/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	2.4/4		**Sand and Clay mix (SC)**, reddish-brown, subangular fine to medium gravel	Odor present.	31
2					2' Medium Silty Sand (SM), black		34
3							21
4							
5	4'-8'	2	2.4/4		5' Medium Sand (SP), brown, lenses of coarse sand and fine gravel, damp	Odor present.	68
6							64
7							7
8							
9	8'-12'	3	2.5/4		8' coarse sand lense		41
10							39
11							34
12							
13	12'-16'	4	2.3/4		13' coarse sand and fine rounded gravel lense		200
14							65
15							57
16							
17	16'-20'	5	2.4/4		17' coarse sand lense		257
18							425
19							605
20							
21	20'-24'	6	3.0/4		**Fine Silty Sand (SM)**, brownish-gray	Slight odor.	830
22					21.5' Coarse Sand (SM), brownish-gray, some fine gravel and silt present		947
23							2117
24							
25	24'-28'	7	4.0/4		**Fine Silty Sand (SM)**, dark gray, wet		2421
26							9999
27							686
28							
29	28'-32'	8	1.9/3/2		29.5 Clay Till (CL), stiff, grey		1344
30							4105
31					**EOB @ 29.9ft bgs**		2120
32							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-244 SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' S of SO-243; S of paint room S wall

ELEVATION: DRILLING CONTRACTOR: **IPS**

DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**

WATER LEVELS: START: 12/21/2006 FINISH: 12/21/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL (FT)	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
1	0'-4'	1	0.5/4		**<u>Sand and Clay mix (SC)</u>**, reddish-brown, some fine gravel present	Odor present.	8
2							
3							
4							
5	4'-8'	2	2.4/4		**<u>Fine to Medium Silty Sand (SM)</u>**, brownish-black 0.125"-1" gravel 5' wood fragment	Odor present.	26
6							25
7							12
8							
9	8'-12'	3	2.5/4		**<u>Medium Sand (SP)</u>**, brown, subrounded fine to medium gravel lenses		8
10							8
11							27
12							
13	12'-16'	4	2.6/4				43
14							125
15							175
16							
17	16'-20'	5	2.5/4		16' medium to coarse sand 17' fine to medium dand, brown	Slight odor	490
18							372
19							610
20							
21	20'-24'	6	2.1/4		fine to medium sand, brown, average grain size increases w depth to **<u>Coarse Sand (SP)</u>**	Slight odor.	898
22							1514
23							1491
24							
25	24'-28'	7	2.3/4		**<u>Fine Silty Sand (SM)</u>**, brownish-gray	Strong odor	4372
26							9999
27							1019
28							
29	28'-32'	8	2.3/4		**clay and gravel mix** 29.3' Clay Till (CL), stiff, gray		5100
30							1314
31					**EOB @ 29.3 ft bgs**		98
32							

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-245	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 10' S of SO-244
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/21/2006 FINISH: 12/21/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
						Odor present.	
1	0'-4'	1	1.8/4		**Sand and Clay mix (SC)**, reddish-brown, subangular gravel		9
2					1.5' Medium to Coarse Silty Sand (SM), brownish-black		6
3							14
4						Odor present.	24
5	4'-8'	2	1.7/4				16
6							10
7							
8					**Medium Sand (SP)**, brown, grades into coarse sand and fine gravel mix with depth		121
9	8'-12'	3	2.5/4				38
10							11
11							
12					12' rounded gravel lenses		123
13	12'-16'	4	2.9/4				125
14							188
15							
16					16 medium sand, brown, granding into Fine Sand (SP) with depth		
17	16'-20'	5	3.0/4				388
18							174
19							384
20					gravel lenses	Slight odor.	575
21	20'-24'	6	2.6/4				980
22					22' Fine Silty Sand (SM), gray		503
23							
24						Moderate odor	1310
25	24'-28'	7	2.3/4				1431
26							3003
27							
28						Moderate odor	6400
29	28'-31'	8	2.0/3		29.4 soft bgs clay lense, gray 29.7 Clay Till (CL) , stiff, gray		2513
30					**EOB @30.0 ft bgs**		901
31							
32							

CH2MHILL	PROJECT NUMBER 348136.TT.01	BORING NUMBER SO-246	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 15' W of SO-245
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/21/2006 FINISH: 12/21/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
						Odor present.	
1	0'-4'	1	2.2/4		**Sand and Clay mix (SC)**, reddish-brown, subangular gravel		23
2					2' Medium silty sand (SM), brownish-black		11
3							12
4						Odor present.	25
5	4'-8'	2	2.7/4		5' Coarse gravel, angular white limestone		19
6					5.6 Coarse Sand (SP), brown, some fine subrounded gravel		26
7							
8						Slight odor	41
9	8'-12'	3	2.6/4		9' Medium Sand (SP), brown, fine/medium subrounded gravel present		75
10							27
11							
12					**Coarse Sand (SP)** with fine rounded gravel, grades into medium sand with depth		60
13	12'-16'	4	2.5/4				74
14							124
15							
16					**Medium Sand (SP)**, brown		201
17	16'-20'	5	2.5/4				130
18							285
19							
20					20' medium sand with small % of silt, brownish-gray	Slight odor.	868
21	20'-24'	6	2.5/4				960
22							1100
23							
24					**Fine Silty Sand (SM)**, gray	Strong odor	3511
25	24'-28'	7	2.6/4				2605
26							9999
27							
28					**29.5 coarse gravel and clay mix**	Strong odor	9000
29	28'-31'	8	2.0/3		29.6 Clay Till (CL), stiff, gray		2814
30							948
31					**EOB @30.0 ft bgs**		
32							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
348136.TT.01	SO-247	SHEET 1 OF 1

SOIL BORING LOG

PROJECT: **OMC Plant 2** LOCATION: 18' W of SO-246
ELEVATION: DRILLING CONTRACTOR: **IPS**
DRILLING METHOD AND EQUIPMENT USED: **Geoprobe**
WATER LEVELS: START: 12/21/2006 FINISH: 12/21/2006 LOGGER: **K. Davis**

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.	PID Reading (ppm)
						Odor present.	
1	0'-4'	1	2.3/4		**Sand and Clay mix (SC)**, reddish-brown, subangular gravel		15
2							21
3							9
4					4.3' white angular limestone gravel and white silt	Odor present.	11
5	4'-8'	2	3.1/4		4.5' Coarse Sand (SP), brown, fine gravel lenses		
							11
6							21
7							
8					8.3' medium sand, brown		27
9	8'-12'	3	2.5/4				43
10							26
11							
12					Medium Sand (SP), brown, gravel lenses present, average grain size decreases with depth		34
13	12'-16'	4	2.8/4				44
14							99
15							
16					16' fine subrounded gravel lenses		94
17	16'-20'	5	2.6/4				142
18							117
19							
20						Slight odor.	150
21	20'-24'	6	3.0/4		20' fine gravel lenses		96
22					22' coarse sand and fine subrounded gravel		303
23							
24					Fine Silty Sand (SM), gray		328
25	24'-28'	7	3.3/4				765
26							355
27							
28					**29.4 Clay Till (CL), stiff, gray**		220
29	28'-31'	8	1.6/3				299
30					**EOB @ 29.6ft bgs**		238
31							
32							

Appendix B
Data Usability Evaluation

Data Usability Evaluation
OMC Plant 2 RI/FS, Waukegan, Illinois
WA No. 018-RICO-0528, Contract No. EP-S5-06-01

PREPARED FOR: U.S. Environmental Protection Agency

PREPARED BY: CH2M HILL

DATE: January 15, 2007

This memorandum presents the data usability evaluation of the analytical results for the annual site-wide groundwater sampling event at the Outboard Marine Corporation (OMC) Plant 2 site in Waukegan, Illinois. Groundwater samples were collected from September 4, 2007 and submitted to an independent laboratory procured by CH2M HILL or a Contract Laboratory Program (CLP) laboratory for analysis. Quality assurance (QA)/quality control (QC) samples were collected to aid in the assessment of data quality. The QA/QC samples collected included field duplicates, matrix spike (MS)/matrix spike duplicates (MSD), equipment blanks, and field blanks.

The CLP data were reviewed by the U.S. Environmental Protection Agency (USEPA) to assess the accuracy, precision, and completeness using the criteria established in the USEPA's *National Functional Guidelines for Superfund Organic Methods Data Review* (January 2005) for CLP SOM01.1 and the ESAT Region 5 Organic Data Validation Criteria Matrix. Data qualifiers were added by USEPA when the QA/QC data indicated a bias.

Non-CLP data were reviewed by CH2M HILL using the criteria established in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (October 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004). Data quality control (QC) summary forms and data reports were reviewed. Data qualifiers were added when the QC data indicated a bias.

Standard data qualifiers were used to classify the data as to their conformance to QA/QC requirements. The data qualifiers are defined as follows:

[=] Detected. The analyte was analyzed for and detected at the concentration level shown.

[U] The specific target analyte was analyzed for, but was not detected above the level of the associated quantitation or detection limit.

[J] The associated value is an estimated quantity. Used when the data indicated the presence of a specific target analyte but at a level below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

[UJ] The component was analyzed for, but not detected at a level equal to or greater than the level of detection or quantification (often the reporting limit). This flag was used when QA/QC data indicated a possible low bias in the analytical data.

[UB] Undetected due to blank contamination. The analyte was detected in the sample and in an associated method, field, or trip blank. The quantity of the analyte is deemed undetected because it falls below the 95 percent confidence interval (5 times the blank concentration). The analyte concentration is potentially the result of contamination.

[R] Rejected. The data is of insufficient quality to be deemed acceptable as reported or otherwise qualified. The data are considered not usable.

Non-CLP Data Evaluation

One hundred and ten groundwater samples were collected and analyzed for dissolved gasses, dissolved metals, anions, alkalinity, sulfide, total organic carbon (TOC) and volatile fatty acids. One light non-aqueous liquid (LNAPL) "waste" sample was collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCS), polychlorinated biphenyls (PCBs), total metals, mercury, and flashpoint. These non-CLP analyses were performed by CT Laboratories, Inc. of Baraboo, Wisconsin.

CH2M HILL performed data validation on 100 percent of the groundwater and LNAPL samples analyzed by CT Laboratories. **Table 1** lists the sample delivery groups (SDGs), and number of samples that were validated.

TABLE 1
Groundwater and Waste Sample Summary
OMC Plant 2, Waukegan, IL

SDG	Number of Samples
62349	11
62388	20
62421 (Waste Sample)	1
62417	17
62432	14
62468	12
62509	16
62558	16
62594	4

Dissolved Gas Analysis by RSK-175

The MS/MSD samples for OMC-W-002, OMC-W-001, and OMC-MW-516D contained percent recoveries that exceeded the QC limits of 70 to 130 percent for methane. The MS/MSD sample for OMC-MW-516D contained percent recoveries that exceeded QC criterion for ethene. Detected concentrations were qualified and flagged "J" due to a potential high bias. The MS/MSD sample for OMC-MW-528D contained percent recoveries for methane that were below the QC limits. The MS sample for OMC-W-001 contained percent recoveries that were below the QC criterion for ethane and ethene. The MS/MSD relative percent difference (RPD) for OMC-W-001 exceeded the QC limits of 20 percent. Nondetected results were qualified and flagged "UJ" and detected concentrations were qualified and flagged "J" due to a potential low bias. The MS/MSD sample for OMC-MW-516D contained percent recoveries below 10 percent for ethane. The sample result was initially rejected and qualified and flagged "R." The sample result was found to be less than 0.40 µg/L, while the action limit for ethane is 10 µg/L. The difference between the result and action limit is 25, greater than the potential variance in the sample result, therefore, the sample result is qualified as being estimated in quantity but not rejected.

Analyte	MS %Recovery	MSD %Recovery	%Recovery Criteria	% RPD	RPD Criteria
Sample OMC-W-002					
Methane	178	196	70-130	--	--
Sample OMC-MW-528D					
Methane	-130	43	70-130	--	--
Sample OMC-W-001					
Ethane	68	--	70-130	36	≤20
Ethene	69	--	70-130	49	≤20
Methane	204	43	70-130	--	--
Sample OMC-MW-516D					
Ethane	0	0	70-130	--	--
Ethene	369	329	70-130	--	--
Methane	176087	187826	70-130	--	--

MS = Matrix Spike; MSD = Matrix Spike Duplicate; -- = Did not exceed QC limit.

The field duplicate percent differences for methane in SDG 62349, Samples 07CM44-10 and 07CM44-11, were found to be outside the acceptable QC criterion of 20 percent. The field duplicate percent difference for ethene and methane in SDG 62432, Samples 07CM44-55 and 07CM44-56, were also found to be outside the QC criterion. Finally, the field duplicate percent difference for ethane in SDG 62509 was found to be outside the QC criterion of 20 percent. Both the native and duplicate samples were qualified as being estimated in quantity and flagged with a "J."

Dissolved Metals by SW-846 6010B

Manganese in the method blanks (MB) and continuing calibration blanks (CCB) within SDGs 62349, 62388, 62417, 62432, and 62468 were reported to contain estimated concentrations above the method detection limit (MDL). According to the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004), sample results less than 5 times the amount found in any blank should be qualified as "UB," not detected above the MDL, and is therefore considered not detected. Sample results found to be greater than 5 times the amount found in the blank are not qualified.

The continuing calibration verification (CCV) sample in SDGs 62388, 62417, and 62468 contained percent recoveries that exceeded the QC limits of 90 to 110 for iron. Detected concentrations were qualified and flagged "J" due to a potential high bias.

The MS samples in SDGs 62388 and 62558 contained percent recoveries below the QC limits of 70 to 130 for iron. Detected concentrations were qualified and flagged "J" due to a potential low bias.

The duplicate relative percent difference for manganese in SDG 62417 was found to be outside the QC criterion of 20 percent. The parent sample was qualified and flagged "UJ."

The percent differences for manganese in SDGs 62388, 62432, and 62432 were found to be outside the acceptable QC limits for the inductively coupled plasma emission (ICP) serial dilution. The *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004) states that when the required 10 percent difference criteria are not met, associated data are to be qualified with a "J" for detected results and qualified "UJ" for nondetected results.

Anions by SW-846 9056

The CCV sample in SDG 62432 contained percent recoveries that exceeded the QC limits of 90 to 110 for chloride. Detected concentrations were qualified and flagged "J" due to a potential high bias.

The MS/MSD samples in SDG 62349 contained percent recoveries that were below the QC limits of 70 to 130 percent for sulfate. The parent sample was qualified and flagged "J" due to a potential low bias.

Alkalinity by EPA Method 310.2

The MS/MSD samples in SDG 62388 and 62432 contained percent recoveries that were below the QC limits of 70 to 130 percent for alkalinity. The parent samples were qualified and flagged "J" due to a potential low bias.

Sulfide by EPA Method 376.1

All QC data were within applicable limits for all the associated SDGs, therefore, no further corrective action was deemed necessary or taken.

Total Organic Carbon by SW-846 9060A

Total organic carbon in the MB and CCBs within SDGs 62388 and 62432 were reported to contain estimated concentrations above the MDL. Sample results less than 5 times the amount found in the blank were qualified as "UB," not detected above the MDL, and are therefore considered not detected. Sample results found to be greater than 5 times the amount found in the blank were not qualified.

The duplicate result for total organic carbon in SDG 62388, Sample 07CM44-25, contained a relative percent difference that exceeded the QC limit of 20 percent. The parent sample was qualified as being estimated in quantity and flagged with a "J."

Volatile Fatty Acids by SW-846 9056M

The duplicate results for acetic, butyric, and proprionic acids in SDG 62388, Sample 07CM44-23, contained relative percent differences that exceeded the QC limit of 20 percent. Detected concentrations were qualified as estimated in quantity and flagged with a "J."

The MSD sample in SDGs 62388 and 62432 contained percent recoveries and relative percent differences that exceeded the QC limits for acetic, lactic, and pyruvic acids. The parent samples were qualified as estimated in quantity and flagged with a "UJ."

LNAPL Waste Sample Summary

Volatile Organic Compounds by SW-846 8260B

The laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) in SDG 62421 contained percent recoveries and relative percent differences that were outside the QC limits for methyl tert-butyl ether, methylene chloride, carbon disulfide, and trans-1,2-dichloroethene. Nondetected results were qualified as estimated in quantity and flagged with a "UJ" and detected concentrations were qualified as estimated in quantity and flagged with a "J."

The CCV in SDG 62421 contained percent differences that exceeded the QC limits of 25 percent for methyl tert-butyl ether and vinyl acetate. Nondetected results were qualified as estimated in quantity and flagged with a "UJ" and detected concentrations were qualified as estimated in quantity and flagged with a "J."

Semi-Volatile Organic Compounds by SW-846 8270C

No qualifiers were applied to any of the analytes within SDG 62421. It should be noted that the reporting limits of all the analytes were raised due to the presence of a large, late-eluting petroleum hydrocarbon pattern. The sample was analyzed at a 1:50 dilution which resulted in matrix interference. This late-eluting hydrocarbon pattern does allow for the use of this data, at its elevated concentrations, and does not result in any result rejection because none of the SVOC analytes that elute at the retention time associated with the hydrocarbon hump were detected.

Polychlorinated Biphenyls by SW-846 8082

No qualifiers were applied to any of the aroclors reported within Sample SDG 62421. Due to a high concentration of Aroclor-1248 in the native sample, the MS/MSD result for this aroclor was diluted to a concentration that was not reportable.

The method reporting limit standard reported several peaks for Aroclor-1016 and Aroclor-1260 outside the QC limits but MDL was analyzed with acceptable results.

Total Metals and Mercury by SW-846 6010B, 7471A

The duplicate relative percent difference for magnesium, selenium, and zinc were found to be outside the QC criterion of 20 percent in SDG 62421. Nondetected results were qualified as estimated in quantity and flagged with a "UJ" and detected concentrations were qualified as estimated in quantity and flagged with a "J."

The MS/MSD sample contained a percent recovery below 10 percent for mercury in SDG 62421. The sample result was initially rejected and qualified and flagged "R" due to matrix interference. The sample result was reported at 0.00068 µg/L while the contract required quantification limit (CRQL) for mercury is 0.2 µg/L. The difference between the result and the CRQL is approximately a factor of 300. The MS/MSD results would have to be less than 0.3 percent before they could affect how the sample result would be used. Therefore, while there is a negative bias, how the sample will be used is not affected. The sample result qualifier has been changed to be estimated in quantity, but not rejected.

The percent differences for chromium, vanadium, and magnesium were found to be outside the acceptable QC limits for the inductively coupled plasma emission (ICP) serial dilution in SDG 62421. The *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004) states that when the required 10 percent difference criteria are not met, associated data are to be qualified with a "J" for detected results and qualified "UJ" for nondetected results.

Flashpoint by EPA Method 1010

All QC data were within applicable limits, therefore no further corrective action was deemed necessary or taken.

Conclusions

The completeness goal for the non-CLP project data is 100 percent. Qualified data, if not rejected, can still be used to make project decisions and is considered to be compliant data. Thus, the data completeness goals stated in the *Quality Assurance Project Plan* (CH2M HILL, December 2004) and *Supplemental Quality Assurance Project Plan* (CH2M HILL, December 2006) were met for this sampling event.

CLP Data Evaluation

One hundred and one groundwater samples were collected and analyzed for VOCs and PCBs in accordance with the CLP statement of work (SOW) *SOM01.1*. The analyses were performed by KAP Technologies, Inc., of The Woodlands, Texas and the data were submitted directly to TechLaw-ESAT, the USEPA's data validation subcontractor.

CH2M HILL conducted a review of the validation performed by USEPA for the groundwater samples in Case Number 36793. One hundred percent of the data were selected for review. **Table 2** lists the case numbers, SDGs, and number of samples that were reviewed.

TABLE 2
Groundwater Sample Summary
OMC Plant2, Waukegan, IL

SDG	Case	Number of Samples
E3MK0	36793	20
E3ML6	36793	19
E3MN6	36793	20
E3MR0	36793	20
E3MT0	36793	22

Upon review of the validation case narratives, the validated results showed several QC issues affecting the quality and usability of the data. The initial calibration verification (ICV) within SDGs E3MK0, E3ML6, and E3MN6 was reported to contain percent relative standard deviations (%RSD) for 1,2,3-trichlorobenzene that exceeded the criteria of 30 percent. The CCV check standard for 1,2,3-trichlorobenzene reported a percent difference (%D) that exceeded the QC range of 30 percent in SDGs E3MK0, E3MN6, E3MR0, and E3MT0. Carbon tetrachloride reported a %D in the CCV that exceeded the QC range in SDGs E3ML6 and E3MN6. The closing CCV in SDG E3MN6 reported a %D greater than 50 percent for 2-hexanone. Nondetected results were qualified as being estimated in quantity and flagged with a "UJ."

One sample within SDGs E3MK0 and E3MN6 was analyzed after a highly contaminated sample with no intervening instrument blank. Therefore, there may be the possibility of carry-over for cis-1,2-dichloroethene and vinyl chloride. Detected concentrations were qualified as estimated in quantity and flagged with a "J." The method blank sample within SDG E3MK0 reported trichloroethene below the Contract-Required Quantification Limit (CRQL). The field blank sample reported concentrations below the CRQL for cis-1,2-dichloroethene and above the CRQL for chloroform in SDG E3ML6. Detected concentrations greater than the CRQL but less than 5 times the blank concentration were elevated to the CRQL and were qualified as "U," not detected The method blank sample within SDGs E3MN6, E3MR0, and E3MT0 reported concentrations of methylene chloride greater than the CRQL. Detected concentrations less than 10 times the blank concentration were elevated to the CRQL and were qualified as "U," not detected. SDGs E3MK0, E3ML6, E3MN6, E3MR0, and E3MT0 reported surrogate recoveries both above and below the QC limits for several analytes. Nondetected results were not qualified for a potential high bias and were flagged "UJ" due to a potential low bias. Detected concentrations were qualified and flagged "J." Acetone and 2-butanone within SDG E3MK0 reported surrogate recoveries below the QC limit of 20 percent. Several analytes reported surrogate recoveries below 20 percent in SDG E3MT0. Non-detected sample results were qualified "R" and are documented in the CLP data validation summary. The internal standard area counts for SDGs E3ML6 and E3MT0 were above the upper limit of the primary criteria of the 12-hour standard for several analytes. Detected concentrations were qualified as estimated in quantity and flagged with a "J." Nondetected results were not qualified. The internal standard area counts for SDG E3MN6, E3MR0, and E3MT0 were less than the lower limit of the primary criteria, but greater than 10 percent of the 12-hour standard for several analytes. The compounds were not detected within the sample. Nondetected results were qualified as estimated in quantity and flagged with a "UJ."

The MS/MSD samples within SDGs E3MK0, E3ML6, and E3MN6 reported percent recoveries below the lower acceptance criteria but greater than 20 percent for benzene. SDG E3ML6 also reported a percent recovery below the acceptance criteria for trichloroethene. The percent recovery for Aroclor-1016 fell below the 20 percent limit for the MS/MSD samples in SDG E3MT0. The parent samples were qualified as estimated in quantity and flagged with a "UJ" for nondetected results and qualified "J" for detected concentrations. The relative percent difference (RPD) between the MS and MSD samples was outside the criteria for trichloroethene in SDG E3MK0. Aroclor-1016 within SDG E3ML6 was greater than the RPD acceptance criterion of 25 percent between the MS and MSD samples.

Detected concentrations of the parent samples were qualified as estimated in quantity and flagged with a "J."

CH2M HILL also conducted a consistency check between the electronic results and the corresponding validation reports submitted by USEPA. Approximately 10 percent of the data submitted was reviewed. No issues were found affecting the data reported, therefore, no corrective action was deemed necessary.

Conclusions

All of the validation reports were reviewed according to the USEPA's *National Functional Guidelines for Superfund Organic Methods Data Review* (January 2005) for CLP SOM01.1 and the ESAT Region 5 Organic Data Validation Criteria Matrix. Therefore, it is deemed that the validation performed by USEPA is correct and complete for those samples analyzed by the CLP. Completeness of the analytical data was assessed for compliance with the amount of data required for decision making. The completeness goal for the project data is 100 percent. Qualified data, if not rejected, can still be used to make project decisions and is considered to be compliant data. Due to the fact that analytical data were rejected by the CLP as a result of a QC issue, the data completeness goals stated in the *Quality Assurance Project Plan* (CH2M HILL, December 2004) and the *Supplemental Quality Assurance Project Plan* (CH2M HILL, December 2006) were not met for this sampling event.

References Cited

CH2M HILL. 2004. *Quality Assurance Project Plan, OMC Plant 2, Waukegan, Illinois*. December.

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U.S. Environmental Protection Agency. 2005. *National Functional Guidelines for Superfund Organic Methods Data Review.* OSWER 9240.1-44/ EPA 540-R-04-001

Data Usability Evaluation
OMC Plant 2 RI/FS, Waukegan, Illinois
WA No. 018-RICO-0528, Contract No. EP-S5-06-01

PREPARED FOR: U.S. Environmental Protection Agency

PREPARED BY: CH2M HILL

DATE: February 2007

This memorandum presents the data usability evaluation of the analytical results for groundwater samples collected during the pilot test activities at the Outboard Marine Corporation (OMC) Plant 2 site in Waukegan, Illinois. Groundwater samples were collected from February 2007 through April 2007 and submitted to an independent laboratory procured by CH2M HILL or a Contract Laboratory Program (CLP) laboratory for analysis. Quality assurance (QA)/quality control (QC) samples were collected to aid in the assessment of data quality. The QA/QC samples collected included field duplicates, matrix spike (MS)/matrix spike duplicates (MSD), equipment blanks, and field blanks.

The CLP data were reviewed by the U.S. Environmental Protection Agency (USEPA) to assess the accuracy, precision, and completeness using the criteria established in USEPA's *National Functional Guidelines for Superfund Organic Methods Data Review* (January 2005) for CLP SOM01.1 and the ESAT Region 5 Organic Data Validation Criteria Matrix. Data qualifiers were added by USEPA when the QA/QC data indicated a bias. Non-CLP data were reviewed by CH2M HILL using the criteria established in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (October 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004). Data quality control (QC) summary forms and data reports were reviewed. Data qualifiers were added when the QC data indicated a bias.

Standard data qualifiers were used to classify the data as to their conformance to QA/QC requirements. The data qualifiers are defined as follows:

[U] The specific target analyte was analyzed for, but was not detected above the level of the associated quantitation or detection limit.

[J] The associated value is an estimated quantity. Used when the data indicated the presence of a specific target analyte but at a level below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

[UJ] The component was analyzed for but not detected at a level equal to or greater than the level of detection or quantification (often the reporting limit). This flag was used when QA/QC data indicated a possible low bias in the analytical data.

[R] Rejected. The data is of insufficient quality to be deemed acceptable as reported or otherwise qualified. The data are considered not usable.

Non-CLP Data Evaluation

One hundred and thirteen groundwater samples were collected and analyzed for dissolved gasses, dissolved metals, anions, alkalinity, sulfide, total organic carbon (TOC), and volatile fatty acids. These non-CLP analyses were performed by CT Laboratories, Inc. of Baraboo, Wisconsin.

CH2M HILL performed data validation on 100 percent of the groundwater samples analyzed by CT Laboratories. **Table 1** lists the sample delivery groups (SDGs), and number of samples that were validated.

TABLE 1
Groundwater Sample Summary
OMC Plant 2, Waukegan, IL

SDG	Number of Samples
58830	16
58853	16
58880	18
58911	20
58918	12
58935	9
58957	3
59376	1
59748	8
59757	10

Dissolved Gas Analysis by RSK-175

The MS/ MSD samples in SDGs 58853 and 58880 contained percent recoveries that exceeded the QC limits of 70 to 130 for methane and ethane. Nondetected results were qualified and flagged “UJ” and detected concentrations were qualified and flagged “J” due to a potential low bias. The duplicate results for ethane and ethene in SDGs 58853, 58830 and 58880 contained relative percent differences that exceeded the QC limits of 20 percent. Nondetected results were qualified and flagged “UJ” and detected concentrations were qualified and flagged “J”. The field duplicate percent differences for ethane and methane in SDG 58853, samples 07CD22-28 and 07CD22-33, were found to be outside the acceptable QC criterion of 20 percent. The field duplicate percent difference for methane in SDG 58957, samples 07CD16-91 and 07CD16-92, was also found to be outside the QC criterion. Both the native and duplicate samples were qualified as “J”.

Dissolved Metals by SW-846 6010B

Iron in the method blank (MB) within SDG 58830 was reported to contain estimated concentrations in the blank above the method detection limit (MDL). According to the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004), sample results less than 5 times the amount found in any blank should be qualified as "UB", not detected above the MDL and is therefore considered not detected. Sample results found to be greater than 5 times the amount found in the blank are not qualified. The percent differences for iron and manganese in SDGs 58957 and 59376 were found to be outside the acceptable QC criterion for the inductively coupled plasma emission (ICP) serial dilution. The *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (October 2004) states that when the required 10 percent difference criteria are not met, associated data are to be qualified with a "J." The field duplicate percent difference for iron and manganese in SDG 58957, samples 07CD16-91 and 07CD16-92, were found to be outside the acceptable QC criterion of 20 percent. Both the native and duplicate samples were qualified as "J."

Anions by SW-846 9056

The field duplicate percent difference for total chloride in SDG 58918, samples 07CD16-72 and 07CD16-73, was found to be outside the acceptable QC criterion of 20 percent. Both the native and duplicate samples were qualified as "J." Nitrite and nitrate in SDG 59376 were extracted by CT Laboratories after the holding time for these analytes had expired. Therefore, total nitrate plus nitrite concentrations were reported instead of nitrate and nitrite individually. No QC issues were found, and therefore, no qualifiers were applied.

Alkalinity by EPA Method 310.2

All QC data were within applicable limits for all the associated SDGs, therefore no further corrective action was deemed necessary or taken.

Sulfide by EPA Method 376.1

The MS/MSD samples in SDG 58911 contained percent recoveries that exceeded the lower QC limits of 70 to 130 percent for sulfide. Nondetected results were qualified and flagged "UJ" and detected concentrations were qualified and flagged "J" due to a potential low bias. The duplicate result for sulfide in SDG 58911, sample 07CD22-61, contained a relative percent difference that exceeded the QC limit of 20 percent. Nondetected results were qualified and flagged "UJ" and detected concentrations were qualified and flagged "J."

Total Organic Carbon by SW-846 9060A

The duplicate result for total organic carbon in SDG 58935, sample 07CD16-90, contained a relative percent difference that exceeded the QC limit of 20 percent. Nondetected results were qualified and flagged "UJ" and detected concentrations were qualified and flagged "J." The field duplicate percent difference for total organic carbon in SDG 59757, samples 07CD27-09 and 07CD27-15, was found to be outside the acceptable QC criterion of 20 percent. Both the native and duplicate samples were qualified as "J."

Volatile Fatty Acids by SW-846 9056M

The duplicate result for formic acid in SDG 58853, sample 07CD22-27, contained a relative percent difference that exceeded the QC limit of 20 percent. The duplicate result for acetic acid in SDG 58957, sample 07CD16-93, also contained a relative percent difference that exceeded the QC limit. Nondetected results were qualified and flagged "UJ" and detected concentrations were qualified and flagged "J." The continuing calibration verification (CCV) check standard reported a percent recovery (%R) that exceeded the QC range for formic acid of 90 to 110 percent in SDG 58935. Detected concentrations of this analyte were qualified and flagged "J," as estimated. Nondetected sample results were qualified and flagged "UJ," as undetected and estimated.

Conclusions

The completeness goal for the non-CLP project data is 100 percent. Qualified data, if not rejected, can still be used to make project decisions and is considered to be compliant data. Thus, the data completeness goals stated in *Quality Assurance Project Plan* (CH2M HILL, December 2004) and *Supplemental Quality Assurance Project Plan* (CH2M HILL, December 2006) were met for this sampling event.

CLP Data Evaluation

Ninety-two groundwater samples were collected and analyzed for VOCs and PCBs in accordance with CLP statement of work (SOW) *SOM01.1*. The analyses were performed by CompuChem Laboratories, Inc., of Cary, North Carolina and the data were submitted directly to TechLaw-ESAT, the USEPA's data validation subcontractor.

CH2M HILL conducted a review of the validation performed by the USEPA for the groundwater samples in case numbers 36202, 36220 and 36266. One hundred percent of the data were selected for review. **Table 2** lists the case numbers, SDGs, and number of samples that were reviewed.

TABLE 2
Groundwater Sample Summary
OMC Plant2, Waukegan, IL

SDG	Case	Number of Samples
E3FG1	36202	19
E3FH8	36202	20
E3FK7	36202	7
E3FL4	36202	20
E3FN5	36220	20
E3FQ5	36220	6
E3FR0	36266	15

Upon review of the validation case narratives, the validated results showed several QC issues affecting the quality and usability of the data. The initial calibration verification (ICV) within SDGs E3FG1 and E3FH8 was reported to contain percent relative standard devations (%RSD) for 1,4-dioxane that exceeded the criteria of 50 percent. The continuing calibration verification (CCV) check standard for 1,4-dioxane also reported a percent difference (%D) that exceeded the QC range of 30 percent in SDGs E3FG1 and E3FH8. Both the initial and continuing calibration average relative response factors (RRF) within SDGs E3FG1, E3FH8, E3FK7, E3FL4, E3FN5, E3FQ5 and E3FR0 were reported to be less than the QC limit of 0.005 for 1,4-dioxane. SDG E3FQ5 also reported a surrogate recovery below the QC limit of 20 percent for 1,4-dioxane. Acetone and 2-butanone within SDGs E3FN5, E3FQ5, and E3FR0 reported surrogate recoveries below the QC limit of 20 percent. Nondetected sample results were qualified "R" for all of the above QC issues and are documented in the CLP data validation summary.

CH2M HILL also conducted a consistency check between the electronic results and the corresponding validation reports submitted by USEPA. Approximately 10 percent of the data submitted was reviewed. No issues were found affecting the data reported, therefore, no corrective action was deemed necessary.

Conclusions

All of the validation reports were reviewed according to USEPA's *National Functional Guidelines for Superfund Organic Methods Data Review* (January 2005) for CLP SOM01.1 and the ESAT Region 5 Organic Data Validation Criteria Matrix. Therefore, it is deemed that the validation performed by USEPA is correct and complete for those samples analyzed by the CLP. Completeness of the analytical data was assessed for compliance with the amount of data required for decision making. The completeness goal for the project data is 100 percent. Qualified data, if not rejected, can still be used to make project decisions and is considered to be compliant data. Due to the fact that analytical data were rejected by the CLP as a result of a QC issue, the data completeness goals stated in the *Quality Assurance Project Plan* (CH2M HILL, December 2004) and the *Supplemental Quality Assurance Project Plan* (CH2M HILL, December 2006) were not met for this sampling event.

References Cited

CH2M HILL. 2004. *Quality Assurance Project Plan, OMC Plant 2, Waukegan, Illinois*. December.

CH2M HILL. 2006. *Supplemental Quality Assurance Project Plan, OMC Plant 2, Waukegan, Illinois*. December.

U.S. Environmental Protection Agency. 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA-540/R-99-008 (PB99-963506).

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U.S. Environmental Protection Agency. 2005. *National Functional Guidelines for Superfund Organic Methods Data Review.* OSWER 9240.1-44/ EPA 540-R-04-001

Appendix C
CSU Bench-Scale Evaluation Report

FINAL REPORT

Bench-Scale Evaluation of ZVI-Clay
OMC Plant 2
Waukegan, Illinois

Developed by

Colorado State University
Center for Contaminant Hydrology

For
CH2M HILL, Inc.

June 5, 2006

Report Contents

1.0 Executive Summary

The work described in the following report was conducted by Colorado State University (CSU) in support of an evaluation of ZVI-Clay technology for soil remediation at OMC Plant 2 in Waukegan, Illinois (Site). Objectives of the work include (1) demonstrating the effectiveness of ZVI-Clay to degrade site-specific contaminants of concern, (2) resolving the relative effectiveness of Peerless, GMA, and QMP iron at application rates of 1 and 3%, (3) investigating the treatment performance with addition of sodium bicarbonate and cement (local source of off-specification product), and (4) evaluating the use of cement to improve post treatment soil strength. A bench scale study was completed by CSU to evaluate ZVI-Clay based on these objectives. This report provides methods, results, and conclusions drawn from the study.

Site samples of soil, groundwater, and NAPL were collected by CH2M Hill and shipped to CSU. In preparation for the study, site soils were saturated with groundwater, spiked with NAPL, and homogenized. The homogeneous soil sample was then loaded into 14 batch reactor vessels. A bench-scale mixing apparatus was used to mix soils within the reactors and deliver treatments into the soil. Following treatment via soil mixing, performance was monitored via soil samples collected after 0, 3, 14, 28, and 59 days. Soil samples were analyzed for chlorinated contaminants of concern (e.g., TCE). Other relevant treatment parameters were monitored including chloride concentration, pH, and oxidation/reduction potential.

The primary contaminant detected was TCE, with an initial concentration of approximately 350 mg/kg. In general, GMA achieved fastest degradation of TCE, followed by Peerless, then QMP. Faster reaction kinetics were achieved through use of 3% versus 1% iron. Use of 1% and 3% GMA iron reduced TCE to 48 mg/kg and 0.11 mg/kg, respectively. Use of 1% and 3% Peerless iron reduced TCE to 190 mg/kg and 12 mg/kg, respectively. Use of 1% and 3% QMP iron reduced TCE to 220 mg/kg and 89 mg/kg, respectively. Other results included:

- Sodium bicarbonate addition (0.5%) did not significantly impact treatment.
- Cement addition (1%, local source) significantly inhibited the reaction rate.

Other parameters including pH, ORP, and chloride concentrations provided evidence that TCE depletion is in fact due to iron-mediated reductive dechlorination. Faster depletion in the treated soil versus in the no-iron control also indicates that iron is driving degradation.

2.0 Disclaimer

Colorado State University provides no guarantees or warranties regarding the performance of the ZVI-Clay technology at a field scale or over extended periods. Parties utilizing information presented herein should recognize the following:

1. Conditions in the field can vary from those in the laboratory;
2. Performance observed during the relatively short duration of the laboratory studies does not guarantee long-term performance;
3. All aspects of the ZVI-Clay treatment processes are not fully understood at this time; and
4. Success at a field scale will be highly dependent on field delivery and mixing of reactive media, stabilizing agents, and target compounds.

3.0 Introduction

The following has been developed per the request of CH2M HILL. The described work was conducted in support of an evaluation of ZVI-Clay technology for treatment of contaminated soils at OMC Plant 2 in Waukegan, Illinois. Objectives of the work include:

1. Demonstrating the effectiveness of ZVI-Clay to degrade trichloroethylene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), and related degradation products in site soils;

2. Resolving the relative effectiveness of Peerless, GMA, and QMP iron at application rates of 1 and 3 percent by dry weight soil;

3. Investigating the effectiveness of sodium bicarbonate and cement (local source of off-specification product) to control low pH condition that could drive excess generation of hydrogen gas; and

4. Evaluating the use of cement to improve post treatment soil strength.

The following presents a final report outlining methods and results.

3.1 Technology Description

ZVI-Clay uses conventional soil mixing equipment to admix reactive media (e.g., ZVI) and stabilizing agents (e.g., clay) with contaminated soil. Reactive media and stabilizing agents are combined in a grout, which is delivered into contaminated soils via a port in the soil-mixing tool (Day and Ryan 1995). Through mixing, heterogeneous subsurface source zones are transformed into uniform bodies of soils, contaminants, reactive media, and stabilizing agents. Within the treated interval, two levels of treatment are achieved: (1) reactive media drives contaminant degradation, while (2) stabilizing agents reduce the hydraulic conductivity. In addition, soil mixing overcomes the challenge of delivering reactive media through complex geologic media. The envisioned benefit of ZVI-Clay treatment is a reduction in contaminant flux from the treated interval.

4.0 Methods

4.1 Materials Receipt and Preparation

Soil cores from the site were collected by CH2M HILL and shipped to CSU in December 2006. Additional materials received by CSU in December 2006 included cement (off-spec product from a source near the site), fly ash (not used in the study), and groundwater and NAPL samples collected from the site. A summary of shipments received is shown in Table 1. In all, 225 pounds of soil were received by CSU. Most of the soils were used in the batch reactor study (see below); approximately 2 gallons of soils were retained for archive purposes.

Table 1: Summary of Materials Received

Date received	Shipment	Contents
12/14/06	3 Coolers	Soil
12/22/06	3 Coolers	Water, NAPL, cement, and kiln dust

Soil cores were processed by CSU on December 22, 2006. Related activities included opening of soil cores, logging soils for physical properties, and dividing samples for subsequent studies. During soil logging, soils were screened for VOCs using an Organic Vapor Analyzer (OVA). Select samples with elevated OVA readings were checked for the presence of NAPL using Sudan IV. Soils were added to a 40-mL vial with water and Sudan IV, a NAPL-soluble dye. None of the analyzed samples were found to contain NAPL using the Sudan IV screening method. A spreadsheet describing observed soil properties is presented in Appendix A.

Groundwater and NAPL samples were stored at 4^{o}C. As described in detail below, groundwater was used to saturate site soils prior to treatment. Site NAPL was added to the soils to spike concentration levels prior to treatment. Liquids added to the soil included 3 liters of site groundwater and 130 mL of NAPL.

4.2 Batch Reactor Study

Batch reactor studies were conducted to evaluate effectiveness using various treatments. The scope of this work included construction of 14 batch column reactors, soil preparation, grout preparation, soil mixing, and sampling. This section describes the work in detail.

4.2.1. Experimental Design

A summary of columns prepared and mixed is shown in Table 2. The experimental design matrix is shown in Figure 1. Except for the unmixed control (column W-1), 1% bentonite clay was added to all columns.

Table 2: Summary of Batch Reactor Columns

Column ID	Description	Iron Amount*	Iron Source	Bentonite Added*	Other Treatment
W-1	Unmixed control	-	-	-	-
W-2	Mixed control	-	-	1%	-
W-3	ZVI-Clay (1%)	1%	Peerless	1%	-
W-4	ZVI-Clay (1%)	1%	GMA	1%	-
W-5	ZVI-Clay (1%)	1%	QMP	1%	-
W-6	ZVI-Clay (3%)	3%	Peerless	1%	-
W-7	ZVI-Clay (3%)	3%	GMA	1%	-
W-8	ZVI-Clay (3%)	3%	QMP	1%	-
W-9	ZVI-Clay ($NaHCO_3$)	1%	Peerless	1%	0.5% $NaHCO_3$
W-10	ZVI-Clay ($NaHCO_3$)	1%	GMA	1%	0.5% $NaHCO_3$
W-11	ZVI-Clay ($NaHCO_3$)	1%	QMP	1%	0.5% $NaHCO_3$
W-12	ZVI-Clay (cement)	1%	Peerless	1%	1% Cement
W-13	ZVI-Clay (cement)	1%	GMA	1%	1% Cement
W-14	ZVI-Clay (cement)	1%	QMP	1%	1% Cement

Notes:
**** Percents indicate mass of material per mass of total dry solids***

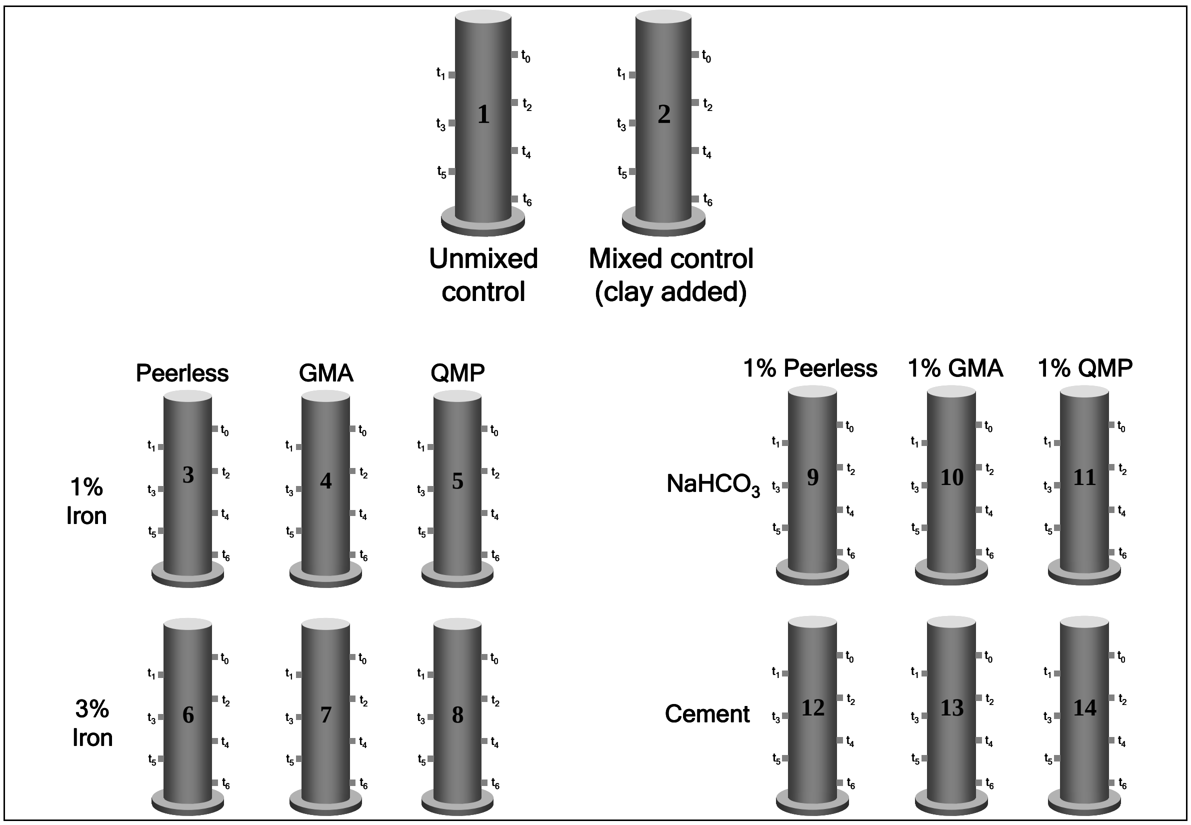


Figure 1: Experimental Design Matrix

4.2.2. Batch Reactor Construction

A photograph of the batch reactor column is shown in Figure 2. The batch reactors used in the study are 40 centimeters in height, 10-cm in diameter, and are constructed of schedule 40 transparent PVC. Sampling ports sealed with Nylon plugs are located at 5-cm intervals along the wall of the column. The top of each column is sealed using a Cherne Monitor-Well plug. The bottom of the column is cemented into a PVC flange; this flange is bolted onto an acrylic sheet to seal the column.

Figure 2: Columns Used for Study: Empty (left) and Filled with Soil.

4.2.3. Soil Preparation

Steps to prepare soils for treatment include homogenization and “spiking”. Homogenization was accomplished using a hand-held drill and paint mixing tool. During homogenization, 3 liters of site water were added to the soil to fully saturate the soils and facilitate mixing. Following homogenization, soils were spiked with the non-aqueous phase liquid (NAPL) sample collected from the site. NAPL was added to the soils in 10 mL increments using a syringe and 9-inch needle. All of the provided NAPL, approximately 130 mL, was added to the soil. Following each DNAPL injection, the soils were vigorously blended using a hand-held drill and paint mixing tool. Blending was repeated over 3 days to ensure homogenization. Once spiking was complete, the soils were loaded into the reactor columns shown in Figure 2.

4.2.4. Grout Preparation

In addition to performing as a drilling fluid, the grout provides a medium for delivery of the iron and clay into the soil matrix. Prior to mixing of each column, a grout mixture was prepared with tap water, clay, iron, and other reagents (e.g., cement or $NaHCO_3$) per the design matrix. The ZVI-Clay grout mixture was delivered into contaminated soils via a positive displacement pump connected to the soil-mixing tool. Detailed compositions of the ZVI-Clay grout mixture used for each column are shown in Appendix B.

4.2.5. Soil Mixing Procedures

Treatment of the columns was completed using the soil-mixing platform shown in Figure 3. The mixing apparatus advances the soil-mixing auger through the columns at a fixed vertical velocity and rate of rotation. The grout is delivered at a controlled rate through a port in the soil-mixing tool. The apparatus is designed to emulate field mixing techniques and achieve repeatable mixing results in a laboratory setting.

Mixing in each column was completed in three down-up passes. ZVI-Clay grout was delivered during the downward portion of the first pass; subsequent passes were completed to achieve a more uniform mixture. Total time to mix each column is about 20 minutes.

Immediately after mixing, the column was sealed as quickly as possible. Tasks completed prior to sealing the column include collection of an initial sample and installation of a gas collection apparatus (Figure 4). In general, the columns were sealed within 5 minutes of completion of mixing and remained sealed throughout the experiment.

Figure 3: Mixing Apparatus – Platform (left) and Soil-Mixing Auger (right)

Figure 4: Gas collection apparatus.

4.2.6. Sampling and Analysis

Soil samples were collected after approximate reaction times of 0, 3, 7, 28, and 56 days. *Time 0* samples were collected from the top of the columns immediately after mixing. Subsequent soil samples were collected from the sampling ports. Soil samples were collected using coring tubes (Figure 5). Upon collection, soil samples were immediately extruded from the coring tube into a vial containing 10 milliliters of MTBE extractant. The soil/extractant mixture was then agitated for approximately one hour using a sieve shaker. Duplicate samples were collected at an approximate frequency of 10%.

Figure 5: Collecting soil samples using a 1-cm diameter coring tube

Samples were analyzed for chlorinated volatile organic compounds (CVOCs) including TCE, PCE, and 1,1,1-TCA. Analysis was conducted on a Hewlett Packard 5890 Series II gas chromatograph (GC) with an Agilent DB-624 column and electron capture detector (ECD).

Soil samples were analyzed for chloride concentration and water content. Water content is used to convert soil concentrations to a dry soil basis. Each sample collected for soil concentration data was analyzed for water content. Water content was measured by heating the samples at 110°C until a constant sample mass was achieved. These parameters were measured in all samples at the end of the experiment.

4.2.7. Post Treatment Analyses

Following collection of the 56-day samples, each column was monitored for chloride concentration, pH, and Oxidation/Reduction Potential (ORP). These parameters provide evidence that reducing conditions are present in the columns and that reductive dechlorination is indeed occurring. Chloride (Cl^-) is released during reductive dechlorination; an increase in chloride in treated columns verifies that contaminants are being dechlorinated. Following completion of the batch reactor study, a sample was removed from each column for chloride analysis. Chloride analysis was performed using an ion-specific electrode (ISE) that was calibrated in 5, 50, and 500 mg/L (as Cl^-) NaCl standard solutions prior to use. pH and ORP values can indicate whether reducing conditions are indeed present in the columns, providing further evidence that iron-mediated degradation is occurring. pH was measured using a combination electrode that was calibrated in pH 4 and 7 buffer solutions. ORP was measured using a combination electrode with 4M Ag/AgCl reference solution. Measured redox potentials were converted to a Standard Hydrogen Electrode basis.

Soil compressive strength was measured for three samples. The proposal stated that unconfined compressive strength would be measured using soil cores removed from the columns after completion of the batch reactor study. However, it was determined that soils removed from the batch reactors are not suitable for this test due to uncontrolled sample water content. As such, separate samples were prepared for testing using archived site soils. In preparation, site soils were dried in an oven at 110°C to remove water. Dried soils were then passed through a number 10 sieve to remove coarse particles. Samples were prepared with 1% bentonite clay and a water content (calculated as mass of water per mass of dry soil) of 18%. Amendments to the three samples included (1) no additional amendments, (2) 1% cement addition, and (3) 0.5% $NaHCO_3$ addition. Methods used for unconfined compressive strength were based on ASTM D2166.

5.0 Results

5.1 Batch Reactor Study Performance Data

The following section presents related results for various iron amounts and sources, cement addition, and $NaHCO_3$ addition in each of the batch reactor columns. A complete listing of measured concentrations is included in Appendix C. Soil concentrations are presented in mass of contaminant per mass of dry soil.

Site specific contaminants of concern were monitored over time. Soils were initially spiked with NAPL provided from the site. TCE was the primary component of the provided NAPL. 1,1,1-TCA was not detected in site soils after addition of NAPL. Small levels of PCE (generally less than 0.2 mg/kg) were also detected. TCE daughter products were not found above quantifiable detection limits.

It is noted that time 0 samples, which were collected immediately after each column was mixed, were collected through the top of the column prior to placing the lid and sealing the column. These values appear low in most columns; there (incorrectly) appears to be a concentration increase from time 0 to 3 days in many cases. These samples are likely biased due to atmospheric exposure during mixing. In future studies, collection of time 0 samples will employ the same technique as subsequent sampling, i.e., through sample ports in the side of the column.

5.1.1. Iron Source and Amount

Iron was evaluated from three sources (Peerless, GMA, and QMP) and in two amounts (1% and 3% of the dry soil weight). Soil results for columns containing 1% iron from all three sources is shown in Figure 6. After 56 days, the best results were obtained using GMA iron, with concentrations reduced to 48 mg/kg. Fifty-six day TCE concentrations were reduced to 190 mg/kg using 1% Peerless and 220 mg/kg using 1% QMP iron.

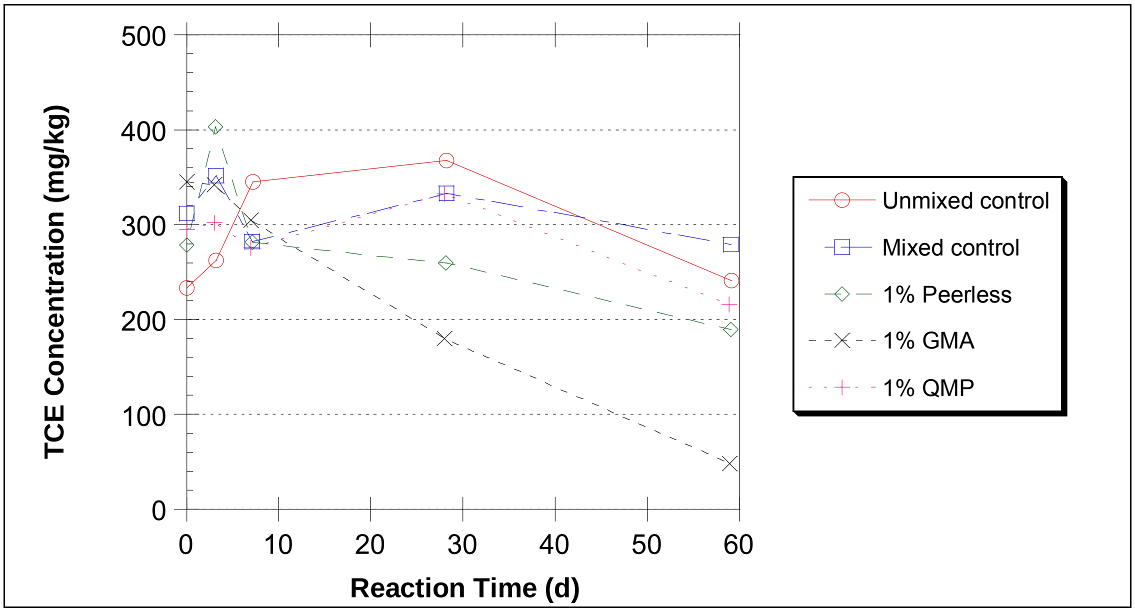


Figure 6: Results from samples containing 1% iron

Results for all columns containing 3% iron are shown in Figure 7. Treatment in these columns clearly proceeded at a faster rate than columns containing 1% iron. In the column containing 3% GMA iron, TCE was reduced to 0.11 mg/kg over the 56-day study. Final TCE concentrations were reduced to 12 mg/kg using 3% Peerless and 89 mg/kg using 3% QMP iron.

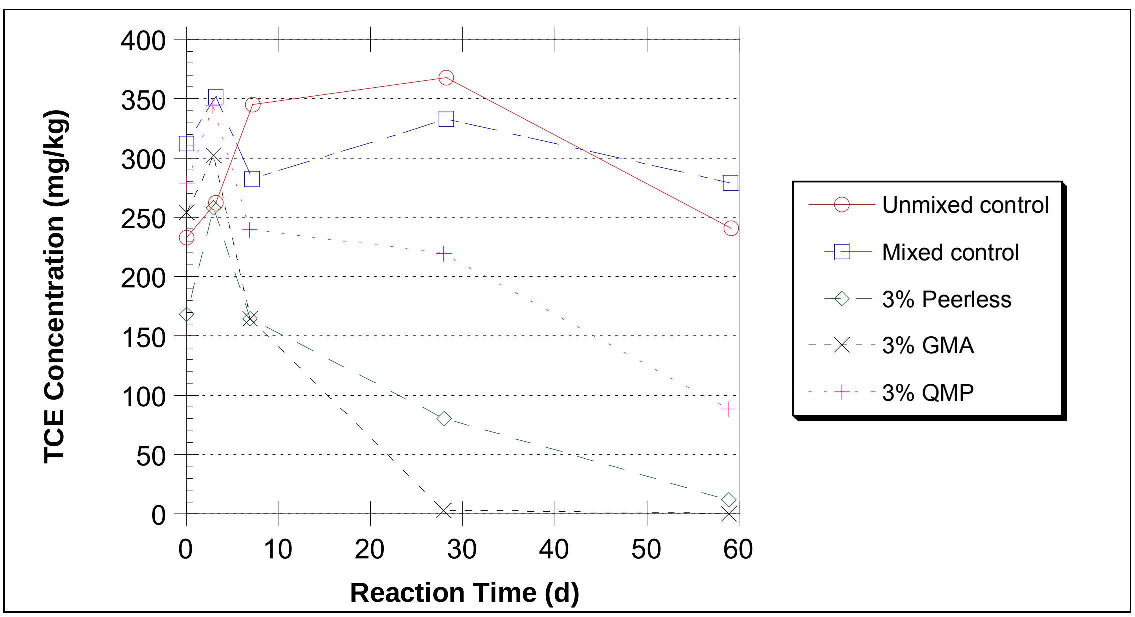


Figure 7: Results from samples containing 3% iron

5.1.2. Addition of $NaHCO_3$

Results for the three columns prepared with sodium bicarbonate ($NaHCO_3$) are shown in Figure 8. Sodium bicarbonate columns were prepared with 1% iron from each source. Figure 9 shows a comparison of results for respective columns prepared with and without $NaHCO_3$ (i.e., columns containing 1% iron). Addition of $NaHCO_3$ did not appear to significantly affect TCE degradation rates.

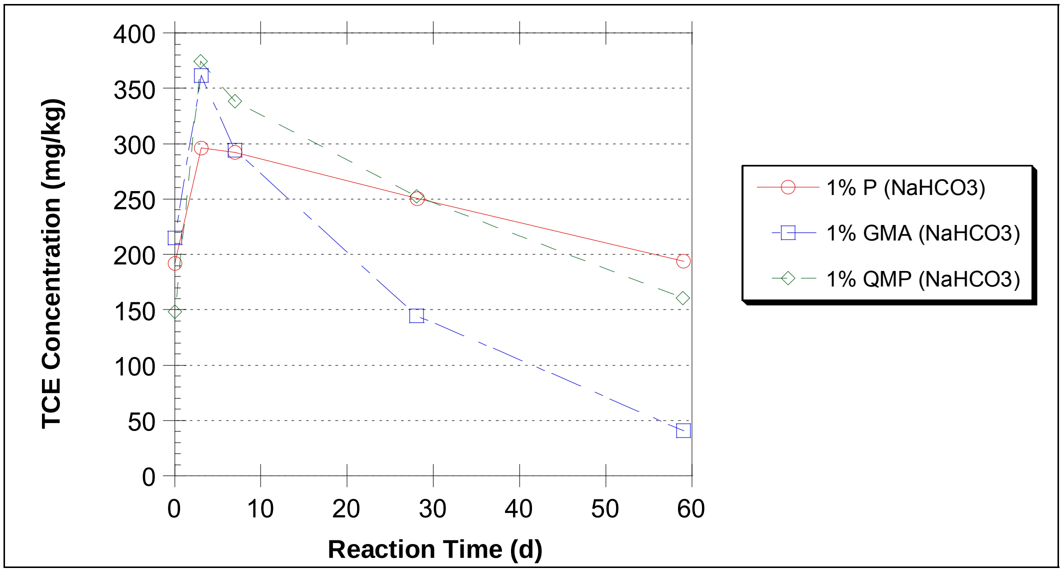


Figure 8: Results from samples containing 1% iron and 0.5% sodium bicarbonate ($NaHCO_3$).

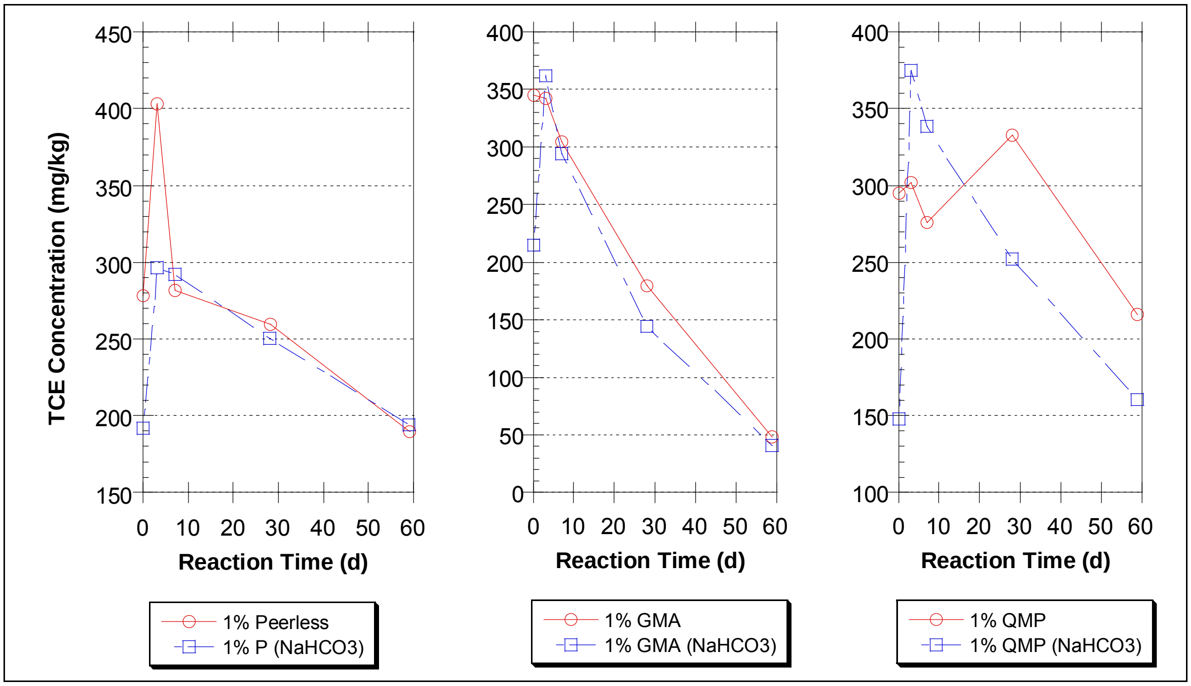


Figure 9: Comparison of treatment results with and without addition of sodium bicarbonate. All columns were treated with 1% iron from the source indicated.

5.1.3. Addition of Cement

Three columns were prepared with 1% cement to evaluate treatment performance. In previous studies conducted by CSU, greater amounts of cement had been added and were found to significantly hinder reaction performance. Our hope was that inclusion of 1% cement would improve soil strength without hindering reaction. The cement used, provided by CH2M Hill, was an off-specification product from a location local to the site.

Results for columns prepared with cement are shown in Figure 10. A slight decrease is noted over the 56-day study. However, the reaction rate is clearly affected by inclusion of 1% cement.

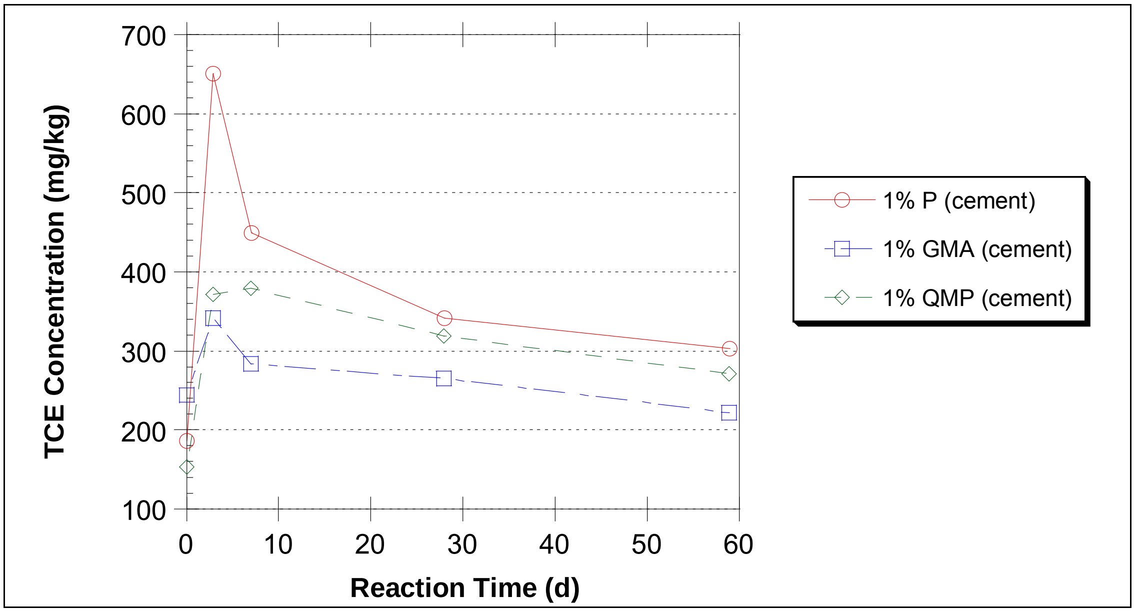


Figure 10: Results from samples containing 1% iron and 1% cement.

5.1.4. Reaction Kinetics

A useful method for comparison of different treatments is the half-life. Half-lives allow for comparison of relative degradation rates using a single number. As such, half-lives provide a means for easier comparison of different treatments for their ability to degrade certain contaminants. Half-lives can also be extrapolated to provide a rough prediction of performance over time.

Contaminant half-lives were estimated using pseudo-first order assumptions. A summary of half-lives for primary contaminants for each column is shown in Table 3.

Table 3: Estimated Contaminant Half-Lives (Days) for Each Treatment.

Column ID	Description	TCE Half-Life (days)
W-1	Unmixed control	210
W-2	Mixed control	301
W-3	1% Peerless	63
W-4	1% GMA	20
W-5	1% QMP	141
W-6	3% Peerless	13
W-7	3% GMA	5
W-8	3% QMP	32
W-9	1% P ($NaHCO_3$)	90
W-10	1% GMA ($NaHCO_3$)	18
W-11	1% QMP ($NaHCO_3$)	47
W-12	1% P (cement)	95
W-13	1% GMA (cement)	108
W-14	1% QMP (cement)	116

5.1.5. Chloride Formation

Reductive dechlorination results in formation of chloride (Cl^-). Chloride was monitored to provide verification that reductive dechlorination is indeed occurring. Results are presented in Table 4.

Table 4: Measured chloride concentrations.

Column ID	Description	Chloride concentration (mg/kg)
W-1	Unmixed control	41
W-2	Mixed control	28
W-3	1% Peerless	243
W-4	1% GMA	370
W-5	1% QMP	76
W-6	3% Peerless	386
W-7	3% GMA	423
W-8	3% QMP	278
W-9	1% P ($NaHCO_3$)	159
W-10	1% GMA ($NaHCO_3$)	228
W-11	1% QMP ($NaHCO_3$)	135
W-12	1% P (cement)	35
W-13	1% GMA (cement)	54
W-14	1% QMP (cement)	66

Elevated chloride concentrations are found in columns of most effective treatment. In particular the measured Cl^- levels in columns containing 3% iron (W-6, W-7, and W-8) are higher than respective columns with less iron. Final Cl^- levels in columns containing cement are much closer to those measured in the untreated control columns, indicating that little Cl^- generation has occurred. Measured chloride data presents evidence that reductive dechlorination is occurring.

5.1.6. Iron Content

Iron content was measured at the conclusion of the batch reactor study. Samples were pulled from columns for iron analysis following collection of 56-day samples. Measured iron concentrations are shown in Table 5. These values represent a snapshot of iron remaining at the end of the experiment.

It is noted that the unmixed and mixed control columns, to which no iron was initially added, were found to contain 0.3% and 0.5% iron, respectively. In addition, some columns contained more iron than was initially added (columns W-6, W-9, W-10, and W-12). Through inspection of the magnetically separated material it was found that some of the site media probably contained magnetic iron and was therefore separated with the added ZVI. That said, measured iron contents generally correlate well with initial values and provide verification that ZVI was indeed delivered into the soils.

Table 5: Iron Remaining at End of Experiment.

Column ID	Description	Target Iron Content[1]	Iron Source	Final Iron content
W-1	Unmixed control	-	-	0.3%
W-2	Mixed control	-	-	0.5%
W-3	1% Peerless	1%	Peerless	0.8%
W-4	1% GMA	1%	GMA	0.8%
W-5	1% QMP	1%	QMP	0.9%
W-6	3% Peerless	3%	Peerless	3.3%
W-7	3% GMA	3%	GMA	2.5%
W-8	3% QMP	3%	QMP	1.9%
W-9	1% P ($NaHCO_3$)	1%	Peerless	1.2%
W-10	1% GMA ($NaHCO_3$)	1%	GMA	1.8%
W-11	1% QMP ($NaHCO_3$)	1%	QMP	1.0%
W-12	1% P (cement)	1%	Peerless	1.1%
W-13	1% GMA (cement)	1%	GMA	0.7%
W-14	1% QMP (cement)	1%	QMP	1.0%

5.1.7. pH and Oxidation/Reduction Potential

pH and Oxidation/Reduction Potential (ORP) were measured in each column at the concusion of the experiment. ORP values were measured relative to a 4M Ag/AgCl reference solution. Reported values are converted to Standard Hydrogen Electrode (SHE). Measured values are shown in Table 6.

Low ORP values in treated columns indicate that reducing conditions are indeed present in treated columns. From a comparison of ORP values in ZVI-treated columns versus untreated control columns, iron appears to be driving the reducing conditions.

Table 6: pH and ORP in each column.

Column ID	Description	ORP (SHE, mV)	pH
W-1	Unmixed control	+352	7.58
W-2	Mixed control	+320	7.72
W-3	1% Peerless	-290	7.42
W-4	1% GMA	-380	7.30
W-5	1% QMP	-375	7.74
W-6	3% Peerless	-422	7.68
W-7	3% GMA	-415	7.61
W-8	3% QMP	-408	7.73
W-9	1% P ($NaHCO_3$)	-468	9.00
W-10	1% GMA ($NaHCO_3$)	-514	9.72
W-11	1% QMP ($NaHCO_3$)	-460	9.05
W-12	1% P (cement)	+70	12.10
W-13	1% GMA (cement)	-8	12.20
W-14	1% QMP (cement)	+55	12.41

5.1.8. QA/QC

Quality analysis/quality control (QA/QC) included collection of duplicate samples, collected from select columns with 56-day samples. Appendix D shows a comparison of results from samples collected and their respective duplicates. Duplicate sample results indicate no significant issues with repeatability of results.

5.2 Gas Generation

After ZVI-Clay remediation of soils, gas generation has frequently been observed. In previous laboratory studies and field applications, samples of the evolved gas have been analyzed and found to be primarily composed of hydrogen (H_2), which evolves as iron corrodes in water. In previous studies, chlorinated solvents have been a minor component of the gas, generally found in the low parts per million (ppm) range. Other components include dechlorination products such as methane or ethane.

Measured volumes of gas generation are presented in Table 7. In general, more gas evolution is noted in columns of most effective treatment. Values presented should be considered as estimation only. The batch reactors are designed to optimize collection of soil samples; measuring gas generation volumes is of ancillary importance. Gas generation volumes can be influenced by several factors such as column disturbance/pressure release during soil sample collection or blockage in the line connecting the Tedlar bag to the reactor.

Possible benefits of H_2 generation include further degradation of chlorinated solvents via biological or other means. Due to flammability, health and safety aspects of H_2 generation should be considered in ZVI-Clay treatment design.

Table 7: Measured volume of gas evolved from each column

Column ID	Description	Gas Generation (mL)
W-1	Unmixed control	150
W-2	Mixed control	50
W-3	1% Peerless	450
W-4	1% GMA	50
W-5	1% QMP	100
W-6	3% Peerless	50
W-7	3% GMA	> 3000*
W-8	3% QMP	500
W-9	1% P ($NaHCO_3$)	350
W-10	1% GMA ($NaHCO_3$)	450
W-11	1% QMP ($NaHCO_3$)	450
W-12	1% P (cement)	0
W-13	1% GMA (cement)	> 1000*
W-14	1% QMP (cement)	0

Note:
*** The volume of gas evolved exceeded the capacity of the Tedlar bag.**

5.3 Unconfined Compressive Strength

Soil samples were prepared and evaluated for unconfined compressive strength. Three samples were prepared for this analysis: (1) no additives, (2) 1% cement, and (3) 0.5% $NaHCO_3$. All samples were prepared with 1% bentonite clay and a water content of 18%. Results are presented in Table 8. In general, unconfined compressive strength results appear low, even for the sample containing 1% cement. This is likely attributable to the high sand content of the soils. Even with addition of 1% clay, the sand content was high enough that the samples lacked cohesion. As such, these values might not reflect strength values that would be achieved in the field.

Table 8: Unconfined compressive strength measurement results.

Sample No.	Treatments	Results (psi)
1	1% clay	1.3
2	1% clay 1% cement	3.6
3	1% clay 0.5% $NaHCO_3$	0.8

6.0 References

Day, S.R. and C. Ryan. 1995. Containment, Stabilization, and Treatment of Contaminated Soils using In situ Soil Mixing. *Geoenvironment 2000*, ed. Y.B. Acar and D.E. Daniel, 1349-65. Reston, Virginia: American Society of Civil Engineers.

Gillham, R.W., and S.F. O'Hannesin. 1994. Enhanced Degradation of Halogenated Aliphatics by Zero-Valent Iron. *Ground Water* 32, no.6: 958-967.

APPENDIX A: LOGGED SOIL DATA

Sample ID	Location	Sample Interval Top	Sample Interval Bottom	Total Mass (g)	Soil Mass (g)	length (cm)	Density (g/mL)	Media	Sorting	Grain Size	Color	OVA
07CW09-01	200	0	2	1,583	1,407	61.5	1.65	sand	poor	silt, sand, and gravel	tan to brown to black	1.4
07CW09-05	200	2	2.5	468	425	19.5	1.57	sand	well	fine	lt. tan	1.3
07CW09-06	200	4	6	1,724	1,721	61	2.04	sand	well	fine	brown to dark brown	1.4
07CW09-07	200	6	7	1,030	1,030	34	2.19	sand	well	fine	tan	1.5
07CW09-08	200	8	10	2,023	2,023	61	2.39	sand	well	fine	lt. tan	3.9
07CW09-02	200	10	12	1,732	1,732	55	2.27	sand	well	fine	tan	6.1
07CW09-03	200	12	14	2,025	2,025	61	2.40	sand	well	fine	tan	2.5
07CW09-04	200	14	16	1,729	1,729	54	2.31	sand	well	fine	lt. tan	14.7
07CW09-09	200A	0	1	790	790	31	1.84	sand	poor	fine sand to pebbles	reddish brown w/black layer	1.4
07CW09-10	200A	1	2.5	1,227	1,227	43	2.06	sand	well	fine	tan to black	1.4
07CW09-18	200A	4	6	1,857	1,857	59	2.27	sand	mod.	fine	tan	2.7
07CW09-19	200A	8	9	943	943	31.5	2.16	sand	well	fine	tan	1.4
07CW09-20	200A	9	10.3	1,160	1,160	38.5	2.17	sand	well	fine	lt. tan	7.9
07CW09-11	200A	12	14	1,968	1,968	61	2.33	sand	well	fine	brown	15.1
07CW09-12	200A	14	15.7	1,623	1,623	51.5	2.27	sand	well	fine	tan	6.8
07CW09-13	200A	16	17	930	930	31	2.17	sand	well	fine	tan to grey	1.7
07CW09-14	200A	17	18.5	1,482	1,482	48	2.23	sand	mod.	fine to coarse	grey	1.9
07CW09-15	200A	20	22	1,784	1,784	61	2.11	sand	well	fine	grey-brown	1.6
07CW09-17	200A	22	24	1,559	1,559	50	2.25	sand	well	fine	grey	1.3
07CW09-16	200A	22	23.6	1,555	1,555	49.5	2.27	sand	well	fine	grey	2.7
07CW09-21	203	12	14	1,791	1,791	61	2.12	sand	mod.	fine	reddish to lt. to dark brown	
07CW09-22	203	12	14					sand	well	fine	lt. brown	3.1
07CW09-22	203	14	15.6	1,396	1,396	48.5	2.08	sand	well	fine	lt. brown	23.6
07CW09-23	203	16	18	1,939	1,939	60	2.33	sand	well	fine	lt. brown	52.7
07CW09-24	203	18	19.6	1,615	1,615	50	2.33	sand	well	fine	lt. brown	65
07CW09-25	203	20	22	2,006	2,006	62	2.34	sand	well	fine	grey	2.5

APPENDIX A: LOGGED SOIL DATA

Sample ID	Location	Sample Interval Top	Sample Interval Bottom	Total Mass (g)	Soil Mass (g)	length (cm)	Density (g/mL)	Media	Sorting	Grain Size	Color	OVA
07CW09-27	204	0	1	769	769	32	1.73	sand	poor	silt, sand, and gravel	reddish brown	1.4
07CW09-28	204	1	3	1,660	1,660	56.5	2.12	sand	poor	silt, sand, and gravel	tan, black at surface	1.4
07CW09-37	204	4	6	2,011	2,011	61.5	2.36	sand	mod.	fine	light tan to brown	1.4
07CW09-38	204	6	7.4	1,258	1,258	38.5	2.36	sand	mod.	fine	lt. tan	1.3
07CW09-39	204	8	10	1,705	1,705	61	2.02	sand	well	fine	light tan	4
07CW09-29	204	10	12	1,344	1,344	55.5	1.75	sand	well	fine	tan	3.1
07CW09-30	204	12	14	1,899	1,899	61	2.25	sand	well	fine	light tan	44
07CW09-31	204	14	15.7	1,639	1,639	52	2.27	sand	well	fine	lt.tan	12.3
07CW09-32	204	16	18	1,944	1,944	61	2.30	sand	well	fine	tan	90.3
07CW09-33	204	18	19.5	1,504	1,504	47.5	2.29	sand	well	fine	tan	46.1
07CW09-34	204	20	22	1,994	1,994	61	2.36	sand	well	fine	grey	3.3
07CW09-35	204	22	23.6	1,602	1,602	49	2.36	sand	well	fine	grey	5.7
07CW09-36	204	24	27.7					sand	well	fine	grey	4000
07CW09-40	204											
07CW09-41	206	0	2	1,517	1,517	61	1.80	sand	poor	silt, sand, and gravel	brown w/ dark grey layer	1.9
07CW09-44	206	2	3	1,010	1,010	35	2.08	sand	well	fine	tan w/dark layer	1.5
07CW09-47	206	4	6	1,762	1,762	61	2.09	sand	well	fine	tan to dark brown	1.3
07CW09-48	206	8	10	1,822	1,822	61	2.16	sand	well	fine	tan	
07CW09-42	206	10	11.5	1,406	1,406	48	2.11	sand	well	fine	tan	1.3
07CW09-43	206	16	18	1,990	1,990	61	2.35	sand	well	fine	grey-brown	2.2
07CW09-45	206	20	21.5					sand	well	fine	tan	5.5
07CW09-46	206	24	28					sand	well	fine	light tan	30
07CW09-55	211	4	6	1,863	1,863	60	2.24	sand	mod.	fine to coarse	lt. brown to brown	1.7
07CW09-49	211	12	13	865	865	31	2.01	sand	well	fine	lt. brown	65.6

APPENDIX A: LOGGED SOIL DATA

Sample ID	Location	Sample Interval Top	Bottom	Total Mass (g)	Soil Mass (g)	length (cm)	Density (g/mL)	Media	Sorting	Grain Size	Color	OVA
07CW09-52	211	20	21	987	987	31	2.30	sand	well	fine	grey	21.9
07CW09-53	211	21	22.2	1,072	1,072	34.5	2.24	sand	well	fine	grey	167
07CW09-54	211	24	28					clay	well	clay	grey	22
07CW09-56	213	0	1	769	769	31	1.79	sand	poor	silt to coarse sand	reddish-brown to black	1.5
07CW09-57	213	1	2.7	1,534	1,534	51	2.17	sand	well	fine	lt. brown	1.8
07CW09-65	213	4	6	1,748	1,748	61	2.07	sand	well	fine	lt. to dark brown	1.8
07CW09-66	213	6	7.8	1,732	1,732	55	2.27	sand	mod.	fine to coarse sand	lt. brown	1.4
07CW09-67	213	8	9	982	982	31	2.29	sand	well	fine	lt. brown	1.5
07CW09-68	213	9	10.5	1,288	1,288	46.5	2.00	sand	mod.	fine to coarse sand	lt. brown	2.4
07CW09-58	213	12	13	1,039	1,039	31	2.42	sand	well	fine	lt. brown	4.3
07CW09-59	213	13	14.3	1,223	1,223	40.5	2.18	sand	well	fine	lt. brown	2.5
07CW09-60	213	16	17	1,018	1,018	31	2.37	sand	well	fine	lt. brown	2.5
07CW09-61	213	17	18.7	1,552	1,552	52.5	2.13	sand	well	fine	lt. tan to grey	1.8
07CW09-62	213	20	21	832	832	31	1.94	sand	well	fine	grey	1.5
07CW09-63	213	21	22.5	1,324	1,324	49	1.95	sand	well	fine	grey	23.9
07CW09-64	213	24	28					sand	well	fine	grey	13.9
07CW09-69	215	0	2	1,683	1,683	61	1.99	sand	poor	silt, sand, and gravel	lt. brown/ brn. black@surface	1.3
07CW09-77	215	4	5	874	874	31	2.03	sand	mod.	fine to coarse	dark brown	1.5
07CW09-78	215	5	6.8	1,745	1,745	57	2.21	sand	well	fine	grey to dark grey	1.4
07CW09-79	215	8	9	987	987	31	2.30	sand	well	fine	lt. tan to brown	3.3
07CW09-80	215	9	10.5	1,414	1,414	47	2.17	sand	well	fine	brown	4.3
07CW09-70	215	12	13	1,009	1,009	31	2.35	sand	well	fine	grey to black	3.2
07CW09-71	215	13	14.4	1,247	1,247	43	2.09	sand	well	fine	grey to dark grey	2.9
07CW09-72	215	16	17	1,002	1,002	31	2.33	sand	well	fine	brownish grey	1.6

APPENDIX A: LOGGED SOIL DATA

Sample ID	Location	Sample Interval Top	Bottom	Total Mass (g)	Soil Mass (g)	length (cm)	Density (g/mL)	Media	Sorting	Grain Size	Color	OVA
07CW09-75	215	21	22.7	1,646	1,646	52	2.29	sand	well	fine	grey	72.1
07CW09-76	215	24	28					sand	well	fine	grey w/ iron stains	999

Totals:	**102,358**	**g**	**2.17**	**g/cm^3**
	102	**kg**	**135**	**lb/ft^3**
	225	**lb**		

APPENDIX B: ZVI-CLAY GROUT MIXTURE DETAILS

Column ID	Category	Water (mL)	Bentonite (g)	Iron Amount (g)	Iron Source	$NaHCO_3$ (g)	Cement (g)
W-1	Unmixed control	--	--	--	--	--	--
W-2	Mixed control	1327	100	--	--	--	--
W-3	ZVI-Clay (1%)	1327	100	100	Peerless	--	--
W-4	ZVI-Clay (1%)	1327	100	100	GMA	--	--
W-5	ZVI-Clay (1%)	1327	100	100	QMP	--	--
W-6	ZVI-Clay (3%)	1327	100	300	Peerless	--	--
W-7	ZVI-Clay (3%)	1327	100	300	GMA	--	--
W-8	ZVI-Clay (3%)	1327	100	300	QMP	--	--
W-9	ZVI-Clay ($NaHCO_3$)	1327	100	100	Peerless	50	--
W-10	ZVI-Clay ($NaHCO_3$)	1327	100	100	GMA	50	--
W-11	ZVI-Clay ($NaHCO_3$)	1327	100	100	QMP	50	--
W-12	ZVI-Clay (cement)	1327	100	100	Peerless	--	100
W-13	ZVI-Clay (cement)	1327	100	100	GMA	--	100
W-14	ZVI-Clay (cement)	1327	100	100	QMP	--	100

APPENDIX C: BATCH REACTOR STUDY RESULTS TABLE

Column number	Sample Time ID	Treatment	Reaction Time (days)	TCE (mg/kg)	PCE (mg/kg)
1	0	Unmixed control	0.00	233.1	0.097
1	A	Unmixed control	3.21	262.2	0.134
1	B	Unmixed control	7.17	345.1	0.176
1	C	Unmixed control	28.21	367.6	0.186
1	D	Unmixed control	59.13	240.7	0.116
2	0	Mixed control	0.00	312.1	0.089
2	A	Mixed control	3.19	351.8	0.198
2	B	Mixed control	7.15	282.5	0.119
2	C	Mixed control	28.19	332.8	0.177
2	D	Mixed control	59.10	278.6	0.142
3	0	1% Peerless	0.00	278.4	0.107
3	A	1% Peerless	3.16	403.2	0.209
3	B	1% Peerless	7.12	281.9	0.113
3	C	1% Peerless	28.16	259.5	0.153
3	D	1% Peerless	59.08	189.7	0.134
4	0	1% GMA	0.00	345.2	0.101
4	A	1% GMA	3.02	342.3	0.185
4	B	1% GMA	6.98	304.4	0.130
4	C	1% GMA	28.02	179.7	0.118
4	D	1% GMA	58.94	48.3	0.060
4	D(dup)	1% GMA	58.94	55.1	0.089
5	0	1% QMP	0.00	295.0	0.119
5	A	1% QMP	3.00	301.9	0.161
5	B	1% QMP	6.96	275.8	0.130
5	C	1% QMP	28.00	332.6	0.181
5	D	1% QMP	58.92	216.0	0.107
5	D(dup)	1% QMP	58.92	262.7	0.184
6	0	3% Peerless	0.00	167.9	0.055
6	A	3% Peerless	2.97	257.9	0.145
6	B	3% Peerless	6.93	164.7	0.092
6	C	3% Peerless	27.97	80.2	0.095
6	D	3% Peerless	58.89	11.9	0.071
6	D(dup)	3% Peerless	58.89	9.2	ND

APPENDIX C: BATCH REACTOR STUDY RESULTS TABLE

Column number	Sample Time ID	Treatment	Reaction Time (days)	TCE (mg/kg)	PCE (mg/kg)
7	0	3% GMA	0.00	254.3	0.075
7	A	3% GMA	2.95	302.3	0.179
7	B	3% GMA	6.91	164.4	0.093
7	C	3% GMA	27.95	2.4	0.044
7	D	3% GMA	58.87	0.1	ND
7	D(dup)	3% GMA	58.87	ND	ND
8	0	3% QMP	0.00	278.8	0.089
8	A	3% QMP	2.92	344.3	0.176
8	B	3% QMP	6.88	239.5	0.099
8	C	3% QMP	27.92	219.6	0.120
8	D	3% QMP	58.84	88.7	0.059
9	0	1% P (NaHCO3)	0.00	191.8	0.058
9	A	1% P (NaHCO3)	3.10	296.3	0.162
9	B	1% P (NaHCO3)	7.03	292.2	0.177
9	C	1% P (NaHCO3)	28.10	250.5	0.177
9	D	1% P (NaHCO3)	59.01	194.1	0.146
9	D(dup)	1% P (NaHCO3)	59.01	194.7	
10	0	1% GMA (NaHCO3)	0.00	215.1	0.069
10	A	1% GMA (NaHCO3)	3.07	361.6	0.216
10	B	1% GMA (NaHCO3)	7.01	294.3	0.178
10	C	1% GMA (NaHCO3)	28.07	144.5	0.080
10	D	1% GMA (NaHCO3)	58.99	40.8	0.037
10	D(dup)	1% GMA (NaHCO3)	58.99	45.1	
11	0	1% QMP (NaHCO3)	0.00	147.9	0.074
11	A	1% QMP (NaHCO3)	3.05	374.6	0.205
11	B	1% QMP (NaHCO3)	6.99	338.3	0.187
11	C	1% QMP (NaHCO3)	28.05	252.3	0.159
11	D	1% QMP (NaHCO3)	58.97	160.5	0.100

APPENDIX C: BATCH REACTOR STUDY RESULTS TABLE

Column number	Sample Time ID	Treatment	Reaction Time (days)	TCE (mg/kg)	PCE (mg/kg)
12	0	1% P (cement)	0.00	186.7	0.122
12	A	1% P (cement)	2.91	651.0	0.371
12	B	1% P (cement)	7.06	449.2	0.227
12	C	1% P (cement)	27.97	341.4	0.169
12	D	1% P (cement)	58.93	303.0	0.157
13	0	1% GMA (cement)	0.00	244.5	0.083
13	A	1% GMA (cement)	2.89	341.3	0.190
13	B	1% GMA (cement)	7.03	283.4	0.151
13	C	1% GMA (cement)	27.95	265.1	0.140
13	D	1% GMA (cement)	58.91	222.2	0.123
13	D(dup)	1% GMA (cement)	58.91	231.9	
14	0	1% QMP (cement)	0.00	153.1	0.063
14	A	1% QMP (cement)	2.87	371.5	0.187
14	B	1% QMP (cement)	7.01	379.4	0.186
14	C	1% QMP (cement)	27.93	318.8	0.151
14	D	1% QMP (cement)	58.89	270.9	0.135

APPENDIX D: QA/QC

Column number	Sample Time ID	Treatment	Reaction Time (days)	TCE (mg/kg)	PCE (mg/kg)
4	D	1% GMA	58.94	48.3	0.060
4	D(dup)	1% GMA	58.94	55.1	0.089
5	D	1% QMP	58.92	216.0	0.107
5	D(dup)	1% QMP	58.92	262.7	0.184
6	D	3% Peerless	58.89	11.9	0.071
6	D(dup)	3% Peerless	58.89	9.2	ND
7	D	3% GMA	58.87	0.1	ND
7	D(dup)	3% GMA	58.87	ND	ND
9	D	1% P (NaHCO3)	59.01	194.1	0.146
9	D(dup)	1% P (NaHCO3)	59.01	194.7	
10	D	1% GMA (NaHCO3)	58.99	40.8	0.037
10	D(dup)	1% GMA (NaHCO3)	58.99	45.1	
13	D	1% GMA (cement)	58.91	222.2	0.123
13	D(dup)	1% GMA (cement)	58.91	231.9	

ADDENDUM TO FINAL REPORT

Bench-Scale Evaluation of ZVI-Clay
OMC Plant 2
Waukegan, Illinois

Developed by

Colorado State University
Center for Contaminant Hydrology

For
CH2M HILL, Inc.

July 23, 2007

Introduction

This addendum to the Final Report (dated June 5, 2007) presents results of additional samples that were collected from the reactors on June 27, 2007. The Final Report presented data collected after approximately 2 months of reaction time. Updated data presented herein reflects treatment results after approximately 6 months of reaction time. The primary objective of this final sample round was to evaluate the sustainability of degradation rates noted after 2 months. This report presents updated sample data and kinetics evaluation.

TCE Data

TCE degradation data is discussed in this section. A table showing TCE concentrations versus time in each column is included in Appendix A.

Control Columns
TCE concentrations in the control columns are presented in Figure 1. No iron was added to these columns. TCE levels are relatively constant over 170 days. Stable concentrations in the control columns provide evidence that concentration reductions in treated columns did result from addition of iron.

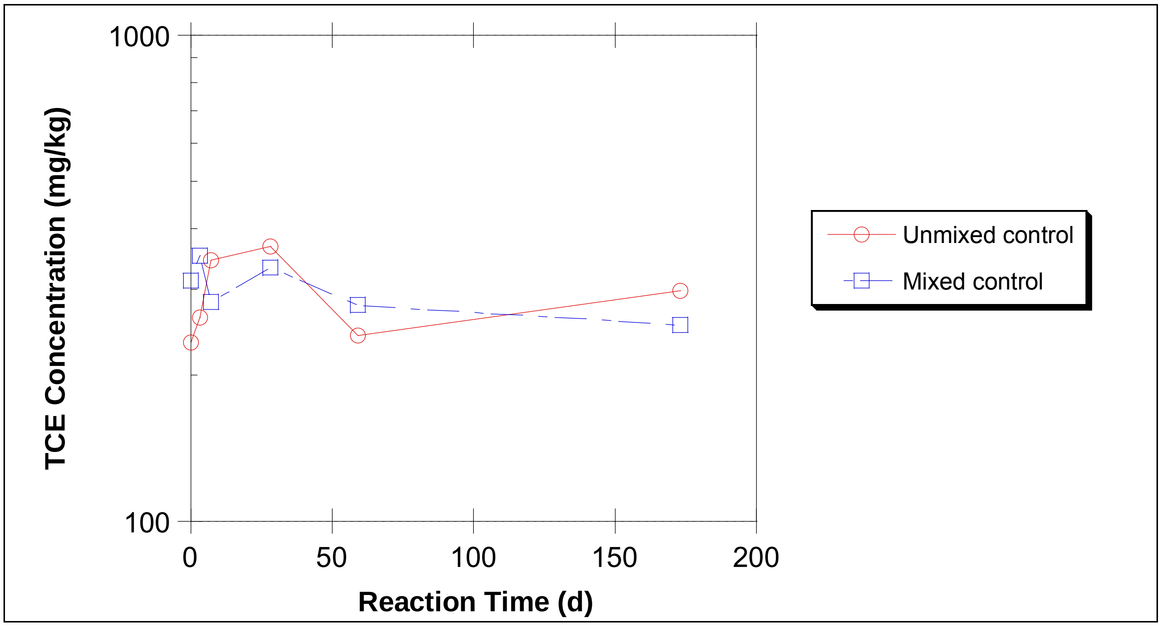


Figure 1. TCE concentration vs. time in the control columns.

Evaluation of Iron Source and Amount
TCE concentrations in columns containing 1% and 3% iron are presented in Figure 2 and Figure 3, respectively. Iron was evaluated from three sources: Peerless, GMA, and QMP.

In general, degradation appears to follow a pseudo-first order kinetic model through 6 months (made apparent by linear appearance on a semi-logarithmic scale). Data from the column containing 3-percent GMA iron appears to stray from the pseudo-first order model at a TCE concentration of less than 0.1 mg/kg. At low concentrations, the reaction rate is possibly slowed due to limited number of contaminant particles remaining that are available for reaction.

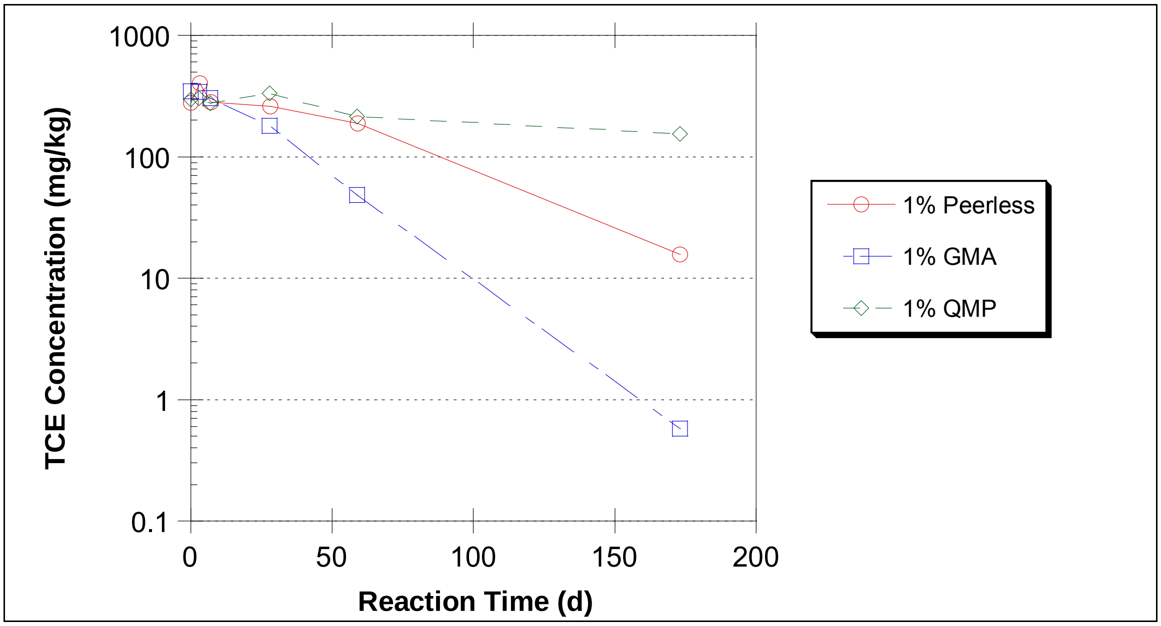


Figure 2. TCE concentration vs. time in 1-percent iron columns.

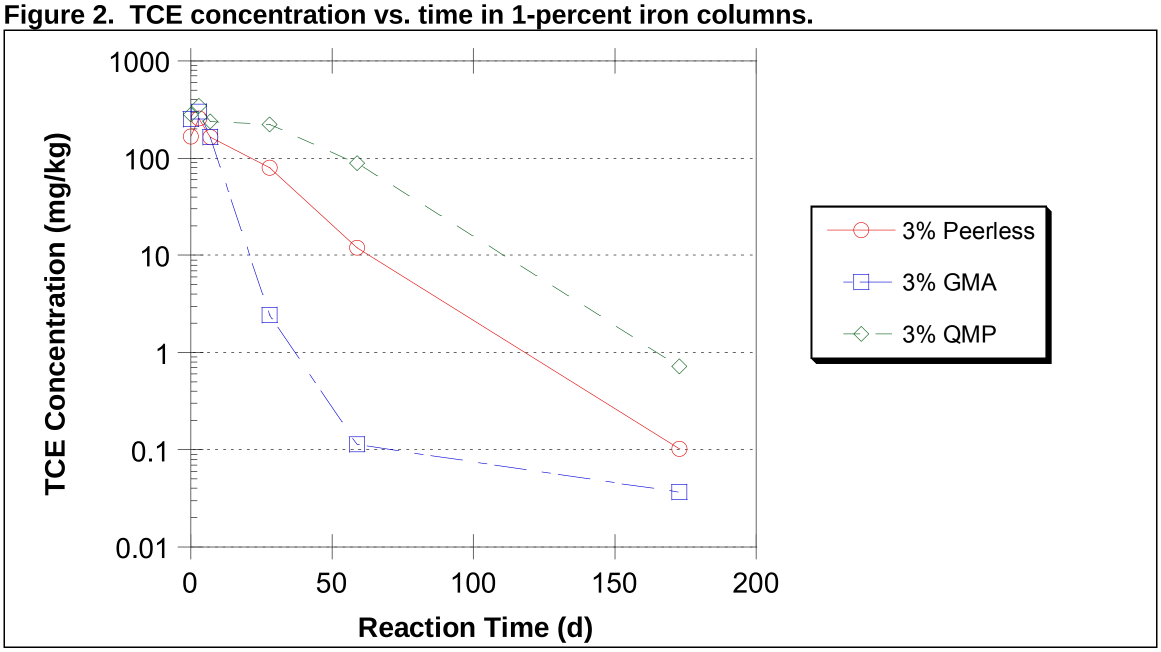


Figure 3. TCE concentration vs. time in 3-percent iron columns.

Addition of Sodium Bicarbonate

TCE concentrations in columns containing 1-percent iron and 0.5% sodium bicarbonate ($NaHCO_3$) are presented in Figure 4. In general, addition of sodium bicarbonate did not significantly affect treatment performance.

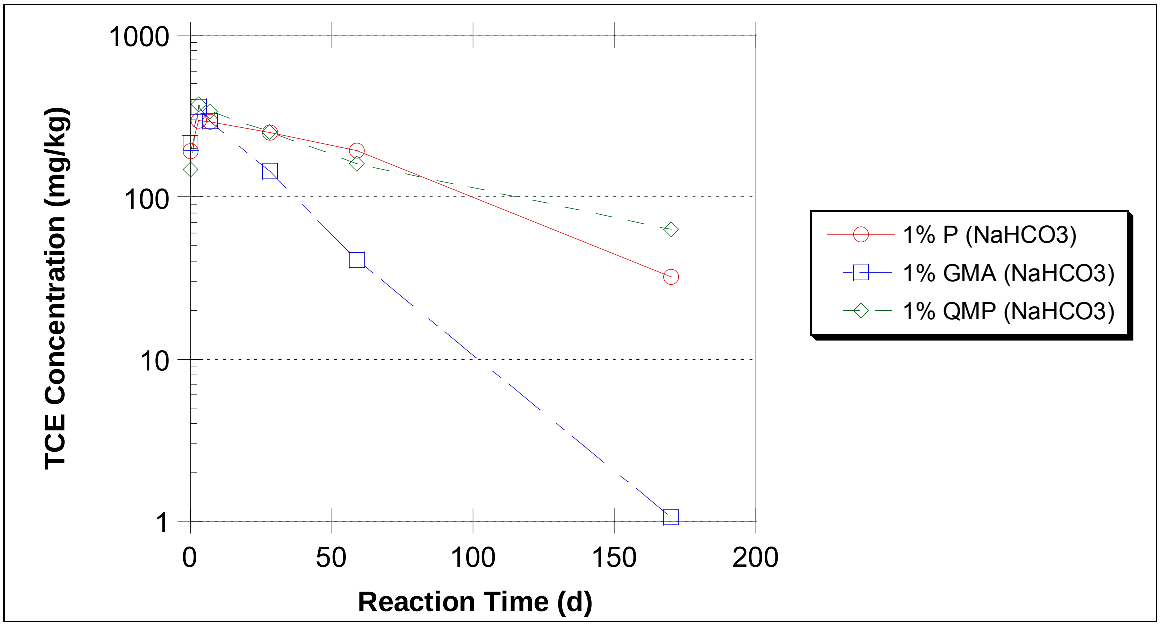


Figure 4. TCE concentration vs. time in columns containing 1-percent iron and 0.5-percent sodium bicarbonate ($NaHCO_3$).

Addition of Cement

TCE concentrations in columns containing 1-percent iron and 1-percent cement are presented in Figure 5. Cement used for the study was an off-specification product from a source local to the site and was provided by CH2M Hill. Cement addition noticeably hindered treatment performance. This is likely due to the high pH conditions.

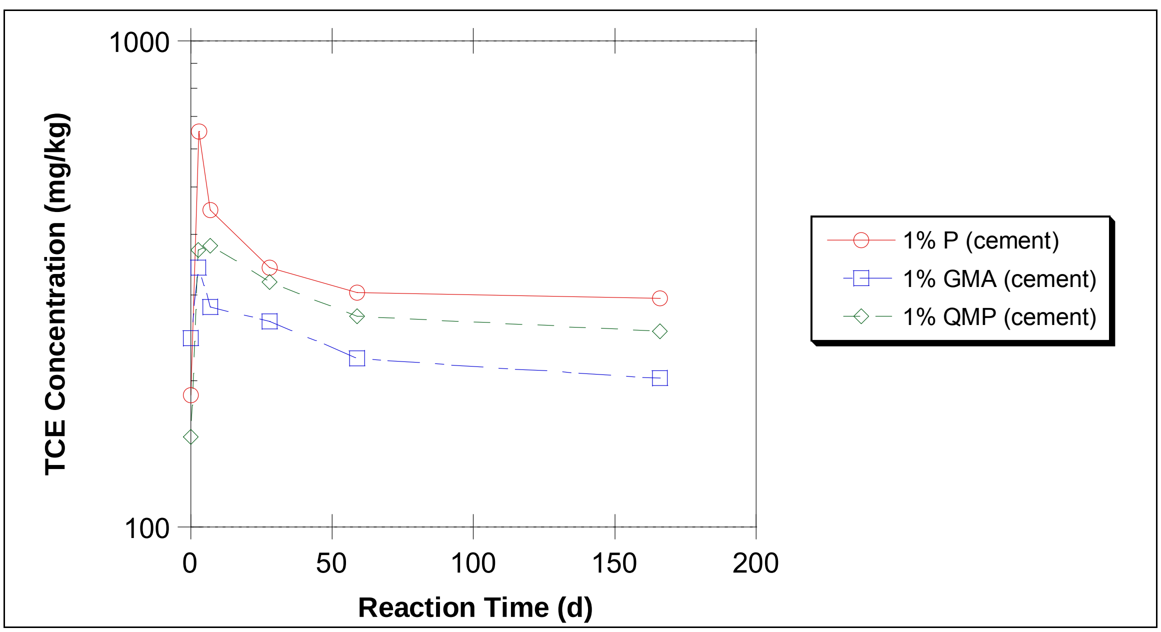


Figure 5. TCE concentration vs. time in columns containing 1-percent iron and 1-percent cement (off-specification product from source local to the site).

Reaction Kinetics

A useful method for comparison of different treatments is the half-life. Contaminant half-lives were estimated using pseudo-first order assumptions. Calculated half-lives based on 2-month data and 6-month data are shown in Table 1.

In most cases, measured half-lives did not change significantly based on 6-month data. This indicates that degradation rates were generally sustained between two months and six months. Notable exceptions include the following treatments: 3-percent GMA iron, no-iron controls, and cement addition. Treatment using 3-percent GMA iron achieved the lowest TCE concentrations in the study (0.04 mg/kg). Below 0.1 mg/kg the concentration strays from the initial pseudo-first order pattern. This is likely due to depletion of TCE that is available for reaction. Remaining TCE may be irreversibly adsorbed in the soil matrix. Other columns that showed significant change in half-lives include the no-iron controls and cement-added treatments. All of these columns had large half-lives to begin with, but showed much-increased half-lives after the 6 month data. In the control columns, this indicates that concentrations are relatively stable with no iron added. In the case of cement-added columns, initially slow degradation rates were further inhibited with the additional time.

Table 1. Estimated TCE Half-Lives.

Column ID	Description	TCE Half-life: 2 month data* (days)	TCE Half-life: 6 month data (days)
W-1	Unmixed control	210	3,466
W-2	Mixed control	301	495
W-3	1% Peerless	63	40
W-4	1% GMA	20	19
W-5	1% QMP	141	178
W-6	3% Peerless	13	15
W-7	3% GMA	5	**
W-8	3% QMP	32	20
W-9	1% P ($NaHCO_3$)	90	57
W-10	1% GMA ($NaHCO_3$)	18	21
W-11	1% QMP ($NaHCO_3$)	47	81
W-12	1% P (cement)	95	462
W-13	1% GMA (cement)	108	315
W-14	1% QMP (cement)	116	1,155

Notes:
* 2-month half-lives were presented in the Final Report (June 5, 2007)
** Degradation rate ceased to follow first-order kinetics after 2 month data was collected. As such, an updated half-life is not calculated.

Conclusions

Updated results from the 6-month study do not significantly alter the conclusions presented in the final report. Key observations include the following:

- Concentrations in control columns remained stable through 6 months. This indicates that reductions in TCE levels in treated columns was indeed due to addition of iron.
- Pseudo-first order kinetics generally held through six months of reaction time.
- Treatment via 3-percent GMA iron reduced TCE to 0.04 mg/kg. Below 0.1 mg/kg, treatment no longer follows first-order kinetics. This is likely due to reduction in the amount of TCE that is available for reaction. Remaining TCE may be irreversibly adsorbed in the soil matrix.

Appendix A: Sample Results

Column number	Treatment	Reaction Time (d)	TCE (mg/kg)
1	Unmixed control	0	233.1
1	Unmixed control	3	262.2
1	Unmixed control	7	345.1
1	Unmixed control	28	367.6
1	Unmixed control	59	240.7
1	Unmixed control	173	298.1
2	Mixed control	0	312.1
2	Mixed control	3	351.8
2	Mixed control	7	282.5
2	Mixed control	28	332.8
2	Mixed control	59	278.6
2	Mixed control	173	253.7
3	1% Peerless	0	278.4
3	1% Peerless	3	403.2
3	1% Peerless	7	281.9
3	1% Peerless	28	259.5
3	1% Peerless	59	189.7
3	1% Peerless	173	15.8
4	1% GMA	0	345.2
4	1% GMA	3	342.3
4	1% GMA	7	304.4
4	1% GMA	28	179.7
4	1% GMA	59	48.3
4	1% GMA	59	55.1
4	1% GMA	173	0.58
5	1% QMP	0	295.0
5	1% QMP	3	301.9
5	1% QMP	7	275.8
5	1% QMP	28	332.6
5	1% QMP	59	216.0
5	1% QMP	59	262.7
5	1% QMP	173	154.3
6	3% Peerless	0	167.9
6	3% Peerless	3	257.9
6	3% Peerless	7	164.7
6	3% Peerless	28	80.2
6	3% Peerless	59	11.9
6	3% Peerless	59	9.2
6	3% Peerless	173	0.10
7	3% GMA	0	254.3
7	3% GMA	3	302.3
7	3% GMA	7	164.4
7	3% GMA	28	2.4
7	3% GMA	59	0.11
7	3% GMA	59	
7	3% GMA	173	0.04

Column number	Treatment	Reaction Time (d)	TCE (mg/kg)
8	3% QMP	0	278.8
8	3% QMP	3	344.3
8	3% QMP	7	239.5
8	3% QMP	28	219.6
8	3% QMP	59	88.7
8	3% QMP	173	0.7
9	1% P (NaHCO3)	0	191.8
9	1% P (NaHCO3)	3	296.3
9	1% P (NaHCO3)	7	292.2
9	1% P (NaHCO3)	28	250.5
9	1% P (NaHCO3)	59	194.1
9	1% P (NaHCO3)	59	194.7
9	1% P (NaHCO3)	170	32.2
10	1% GMA (NaHCO3)	0	215.1
10	1% GMA (NaHCO3)	3	361.6
10	1% GMA (NaHCO3)	7	294.3
10	1% GMA (NaHCO3)	28	144.5
10	1% GMA (NaHCO3)	59	40.8
10	1% GMA (NaHCO3)	59	45.1
10	1% GMA (NaHCO3)	170	1.1
11	1% QMP (NaHCO3)	0	147.9
11	1% QMP (NaHCO3)	3	374.6
11	1% QMP (NaHCO3)	7	338.3
11	1% QMP (NaHCO3)	28	252.3
11	1% QMP (NaHCO3)	59	160.52
11	1% QMP (NaHCO3)	170	63.1
12	1% P (cement)	0	186.7
12	1% P (cement)	3	651.0
12	1% P (cement)	7	449.2
12	1% P (cement)	28	341.4
12	1% P (cement)	59	303.0
12	1% P (cement)	166	295.3
13	1% GMA (cement)	0	244.5
13	1% GMA (cement)	3	341.3
13	1% GMA (cement)	7	283.4
13	1% GMA (cement)	28	265.1
13	1% GMA (cement)	59	222.2
13	1% GMA (cement)	59	231.9
13	1% GMA (cement)	166	202.54
14	1% QMP (cement)	0	153.1
14	1% QMP (cement)	3	371.5
14	1% QMP (cement)	7	379.4
14	1% QMP (cement)	28	318.8
14	1% QMP (cement)	59	270.92
14	1% QMP (cement)	166	252.6

Appendix D

BIOCHLOR Modeling File

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

OMC Plant 2
Source Zone 2
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes (selected) / Ethanes

1. ADVECTION

Seepage Velocity*	Vs	16.3	(ft/yr)
or			
Hydraulic Conductivity	K	4.3E-03	(cm/sec)
Hydraulic Gradient	i	0.0011	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	19.8	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.45	(kg/L)
FractionOrganicCarbon, foc	9.7E-4	(-)

Partition Coefficient	Koc		R	
PCE	155	(L/kg)	1.73	(-)
TCE	166	(L/kg)	1.78	(-)
DCE	36	(L/kg)	1.17	(-)
VC	19	(L/kg)	1.09	(-)
ETH	302	(L/kg)	2.42	(-)

Common R (used in model)* = 1.73

4. BIOTRANSFORMATION **-1st Order Decay Coefficient***

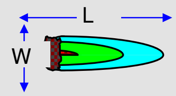
Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.347	2.00	0.79
TCE → DCE	0.693	1.00	0.74
DCE → VC	2.310	0.30	0.64
VC → ETH	1.155	0.60	0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	30	(yr)
Modeled Area Width*	300	(ft)
Modeled Area Length*	1050	(ft)
Zone 1 Length*	1050	(ft)
Zone 2 Length*	0	(ft)



Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Continuous Single Planar

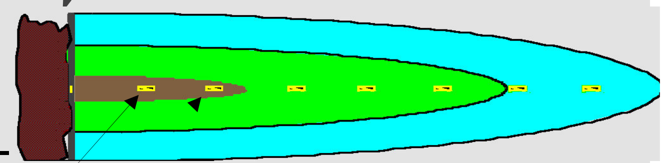
Source Options

Source Thickness in Sat. Zone* 15 (ft)

Width* (ft) Y1: 100

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0
TCE	210.0	0
DCE	70.0	0
VC	.57	0
ETH		0

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	210.0	78.0		.034							
DCE Conc. (mg/L)	70.0	5.0		.009							
VC Conc. (mg/L)	0.6	.79		.051							
ETH Conc. (mg/L)											
Distance from Source (ft)	0	100		300							
Date Data Collected	2007										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | ***Help*** | Restore Formulas | RESET | ***SEE OUTPUT*** | Paste Example

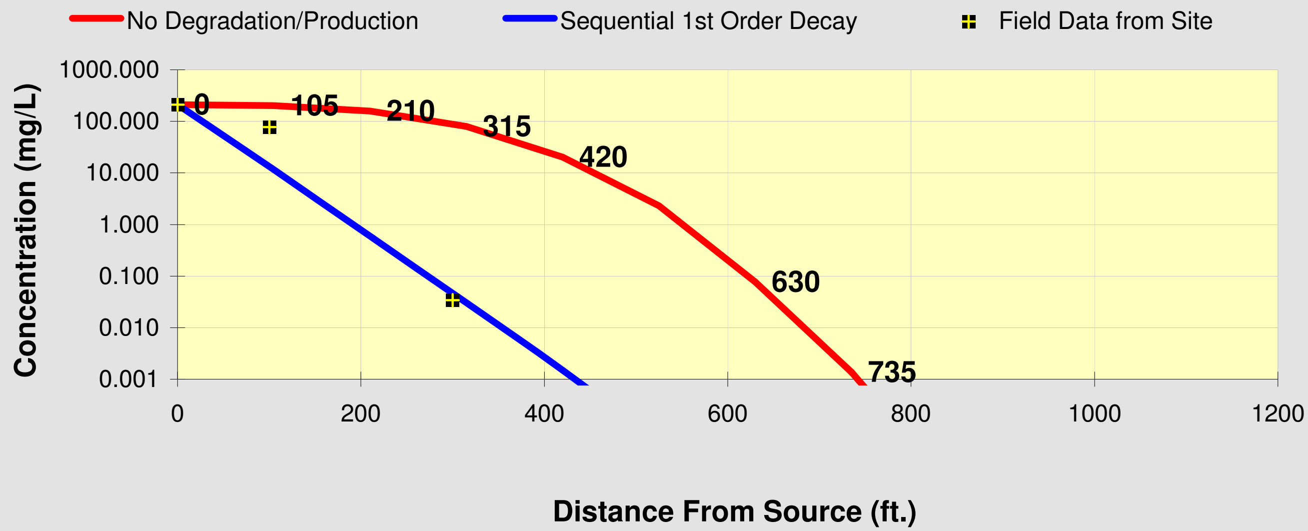
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	105	210	315	420	525	630	735	840	945	1050
No Degradation	210.000	202.595	158.010	79.402	20.354	2.308	0.077	0.001	0.000	0.000	0.000
Biotransformation	209.9999	11.529	0.597	0.030	0.001	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	100		300							
Field Data from Site	210.000	78.000		0.034							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

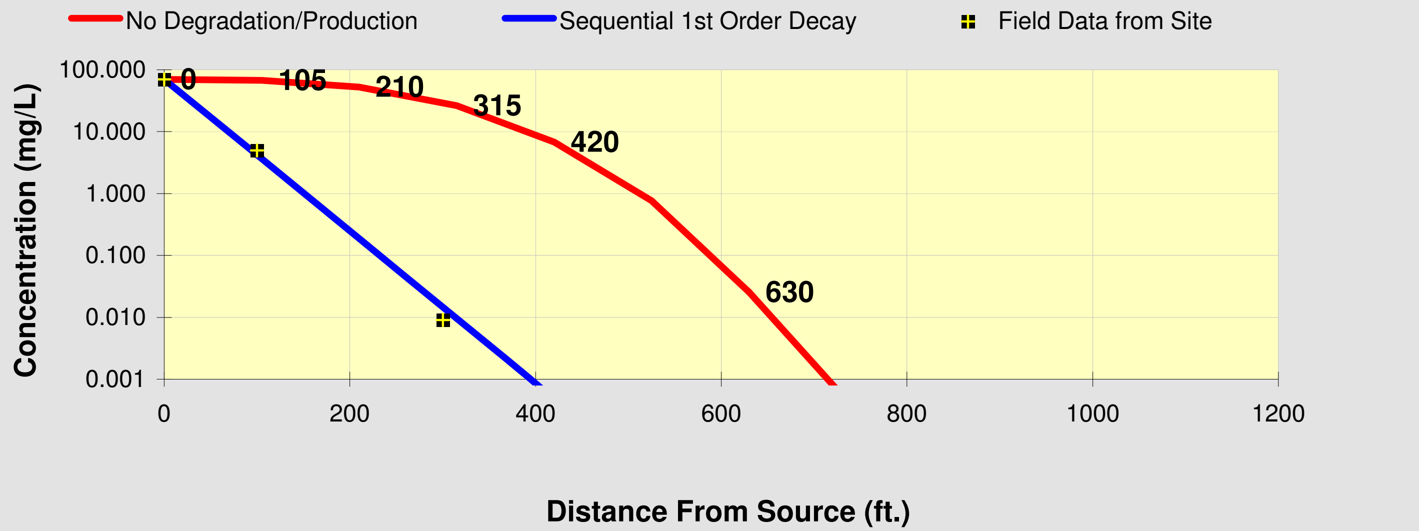
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	105	210	315	420	525	630	735	840	945	1050
No Degradation	70.000	67.532	52.670	26.467	6.785	0.769	0.026	0.000	0.000	0.000	0.000
Biotransformation	70.0000	3.649	0.189	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	100		300							
Field Data from Site	70.000	5.000		0.009							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

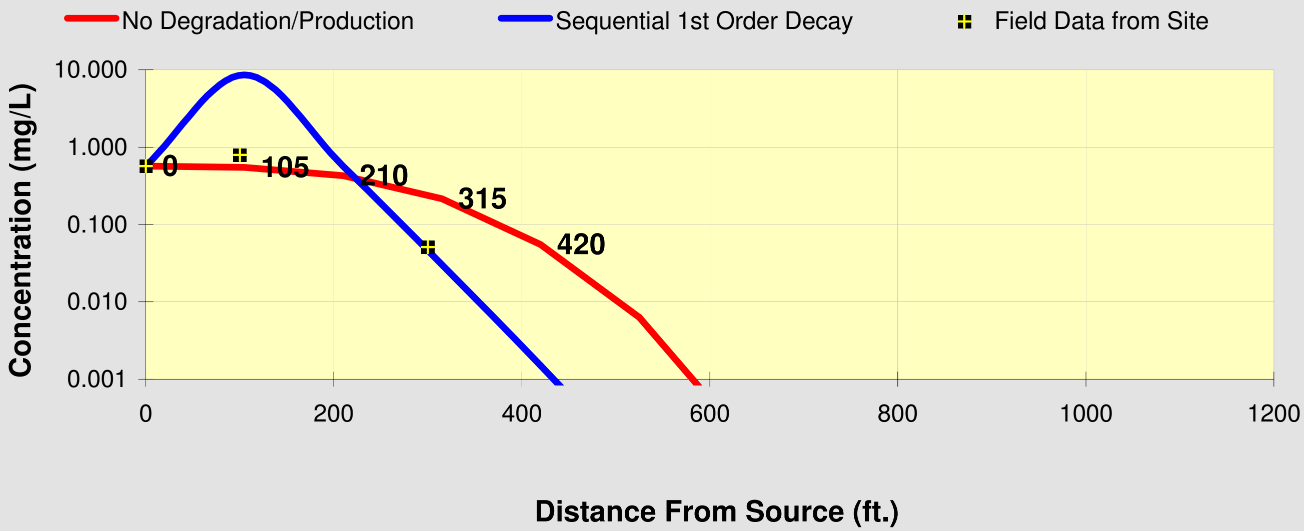
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	105	210	315	420	525	630	735	840	945	1050
No Degradation	0.570	0.550	0.429	0.216	0.055	0.006	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.5700	8.546	0.563	0.030	0.002	0.000	0.000	0.000	0.000	0.000	0.000

	Monitoring Well Locations (ft)										
	0	100		300							
Field Data from Site	0.570	0.790		0.051							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / ***Distance from Source (ft)***

	0	105	210	315	420	525	630	735	840	945	1050
120	0.000	0.003	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	3.648	0.237	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0	210.000	11.529	0.597	0.030	0.001	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	3.648	0.237	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.003	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.2E+5	6.4E+3	3.7E+2	2.1E+1	1.1E+0	4.7E-2	1.3E-3	1.7E-5	1.1E-7	2.6E-10	2.6E-13

Show No Degradation

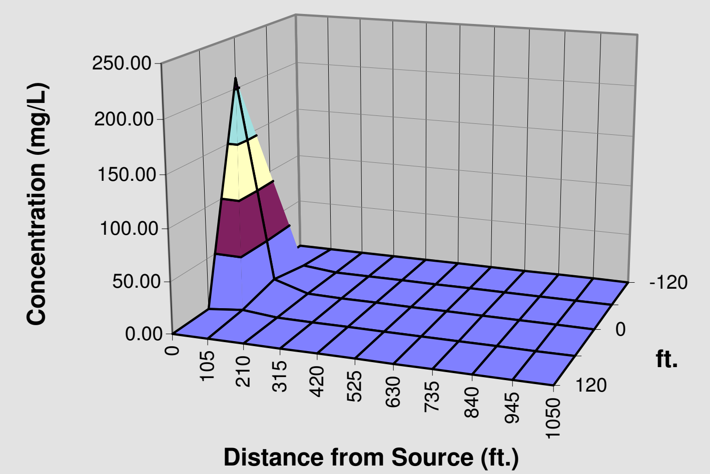
Show Biotransformation

Time: 30 yr

Target Level: **0.005** mg/L

Displayed Model: **Biotransformation**

Displayed Compound: **TCE**



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons Plume Mass If No Degradation	1285.5	*(Kg)*
- Plume Mass If Biotransformation/Production	173.1	*(Kg)*
Mass Removed	1112.3	*(Kg)*
% Biotransformed =	**+86.5%**	
% Change in Mass Rate =	**100.0 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	2.12	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Plot All Data | Plot Data > Target | **Mass HELP** | **To Centerline** | **Return to Input**

Start Here → ○ PCE ○ TCE ◉ DCE ○ VC ○ ETH

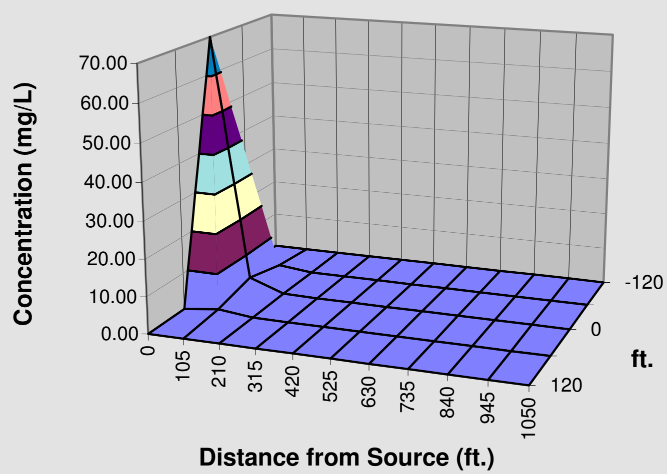
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft)	*Distance from Source (ft)*										
	0	105	210	315	420	525	630	735	840	945	1050
120	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	1.154	0.075	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	70.000	3.649	0.189	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	1.154	0.075	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	4.0E+4	2.0E+3	1.2E+2	6.5E+0	3.4E-1	1.5E-2	4.0E-4	5.5E-6	3.3E-8	8.2E-11	8.1E-14

Show No Degradation

Show Biotransformation

Time: 30 yr   Target Level: **0.070** mg/L   Displayed Model: **Biotransformation**   Displayed Compound: **DCE**



Plot All Data   Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	428.5	*(Kg)*
- Plume Mass If Biotransformation/Production	57.2	*(Kg)*
Mass Removed	371.2	*(Kg)*
% Biotransformed =	**+86.6%**	
% Change in Mass Rate =	**100.0 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	1.70	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP   **To Centerline**   **Return to Input**

Start Here → ○ PCE ○ TCE ○ DCE ◉ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

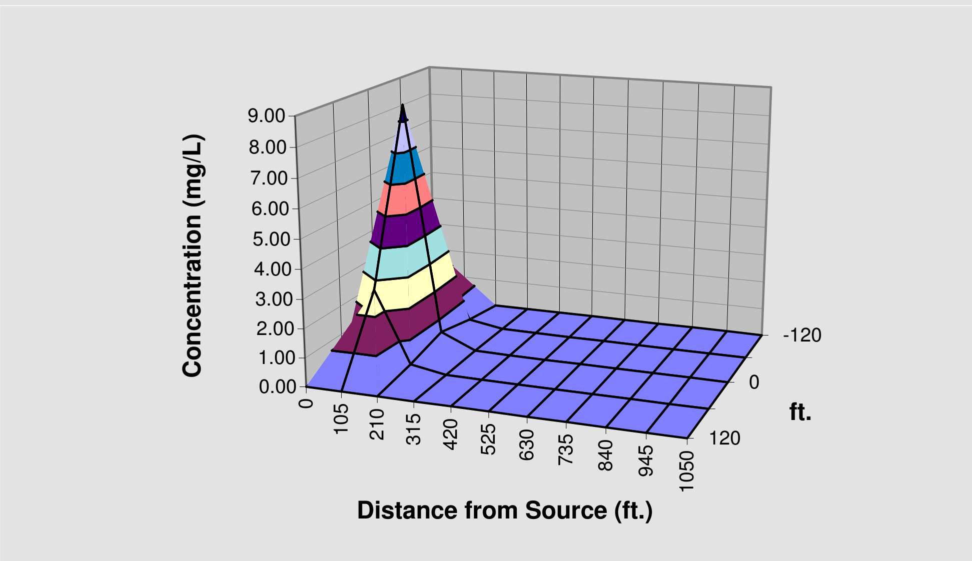
Transverse Distance (ft) — ***Distance from Source (ft)***

	0	105	210	315	420	525	630	735	840	945	1050
120	0.000	0.003	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	0.000	2.704	0.223	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000
0	0.570	8.546	0.563	0.030	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-60	0.000	2.704	0.223	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.003	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	3.2E+2	4.8E+3	3.5E+2	2.0E+1	1.1E+0	4.8E-2	1.3E-3	1.8E-5	1.1E-7	2.7E-10	2.6E-13

Show No Degradation

Show Biotransformation

Time: 30 yr Target Level: **0.002** mg/L Displayed Model: **Biotransformation** Displayed Compound: **VC**



Plot All Data Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	3.5	*(Kg)*
- Plume Mass If Biotransformation/Production	21.2	*(Kg)*
Mass Removed	-17.7	*(Kg)*

If "Can't Calc.", make model area longer

% Biotransformed = -508.6 %

% Change in Mass Rate = 100.0 % (source to edge)

See acre-ft

Current Volume of Ground Water in Plume	2.12	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP **To Centerline** **Return to Input**

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

OMC Plant 2
Source Zone 4
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes (selected) / Ethanes

1. ADVECTION

Seepage Velocity*	Vs	405.0	(ft/yr)
or			
Hydraulic Conductivity	K	3.1E-02	(cm/sec)
Hydraulic Gradient	i	0.0038	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	16.249	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.45	(kg/L)
FractionOrganicCarbon, foc	1.1E-3	(-)

Partition Coefficient	Koc		R	
PCE	426	(L/kg)	3.37	(-)
TCE	166	(L/kg)	1.92	(-)
DCE	36	(L/kg)	1.20	(-)
VC	19	(L/kg)	1.10	(-)
ETH	302	(L/kg)	2.68	(-)

Common R (used in model)* = 1.92

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1

	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.347	2.00	0.79
TCE → DCE	4.620	0.15	0.74
DCE → VC	8.663	0.08	0.64
VC → ETH	11.550	0.06	0.45

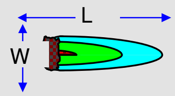
Zone 2

	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	30	(yr)
Modeled Area Width*	500	(ft)
Modeled Area Length*	1000	(ft)
Zone 1 Length*	1000	(ft)
Zone 2 Length*	0	(ft)



Zone 2= L - Zone 1

6. SOURCE DATA

TYPE: Continuous
Single Planar

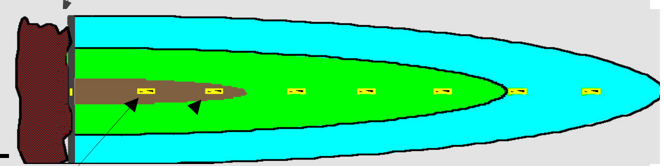
Source Options

Source Thickness in Sat. Zone* 15 (ft)

Y1
Width* (ft) 10

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0
TCE	.83	0
DCE	2.0	0
VC	.9	0
ETH		0

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	.83		.73			.001					
DCE Conc. (mg/L)	2.0		.54			.001					
VC Conc. (mg/L)	0.9		.49			.001					
ETH Conc. (mg/L)											
Distance from Source (ft)	0		150			450					
Date Data Collected	2007										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | *Help* | Restore Formulas | RESET | *SEE OUTPUT* | Paste Example

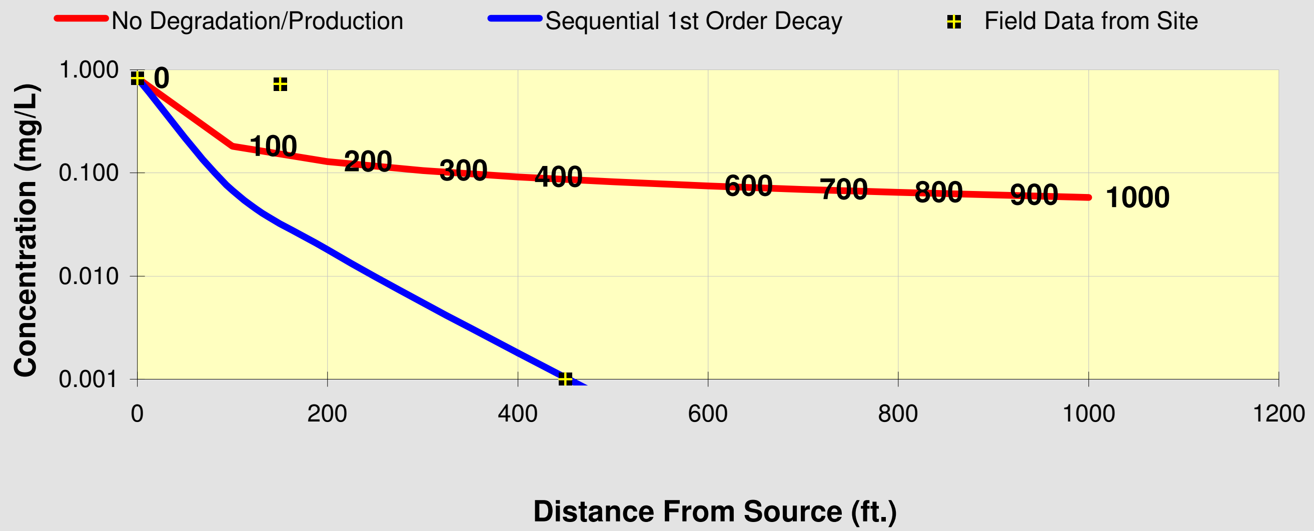
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	0.830	0.181	0.129	0.106	0.092	0.082	0.075	0.069	0.065	0.061	0.058
Biotransformation	0.8300	0.068	0.018	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0		150			450					
Field Data from Site	0.830		0.730			0.001					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

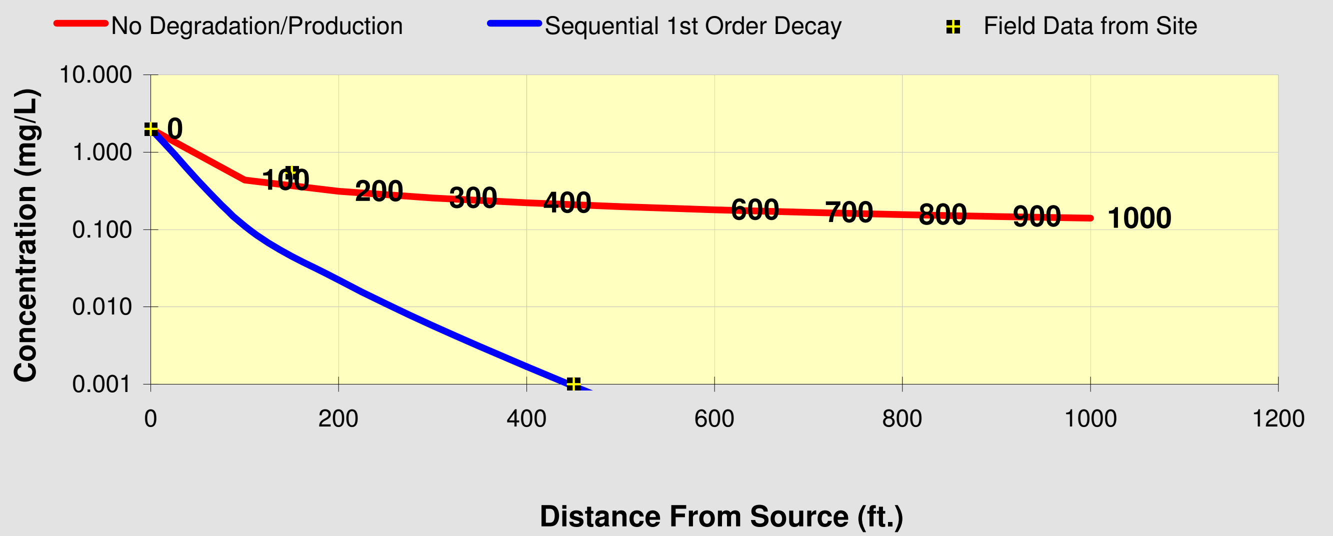
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	2.000	0.437	0.311	0.254	0.221	0.197	0.180	0.167	0.156	0.147	0.140
Biotransformation	2.0000	0.110	0.022	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0		150			450					
Field Data from Site	2.000		0.540			0.001					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

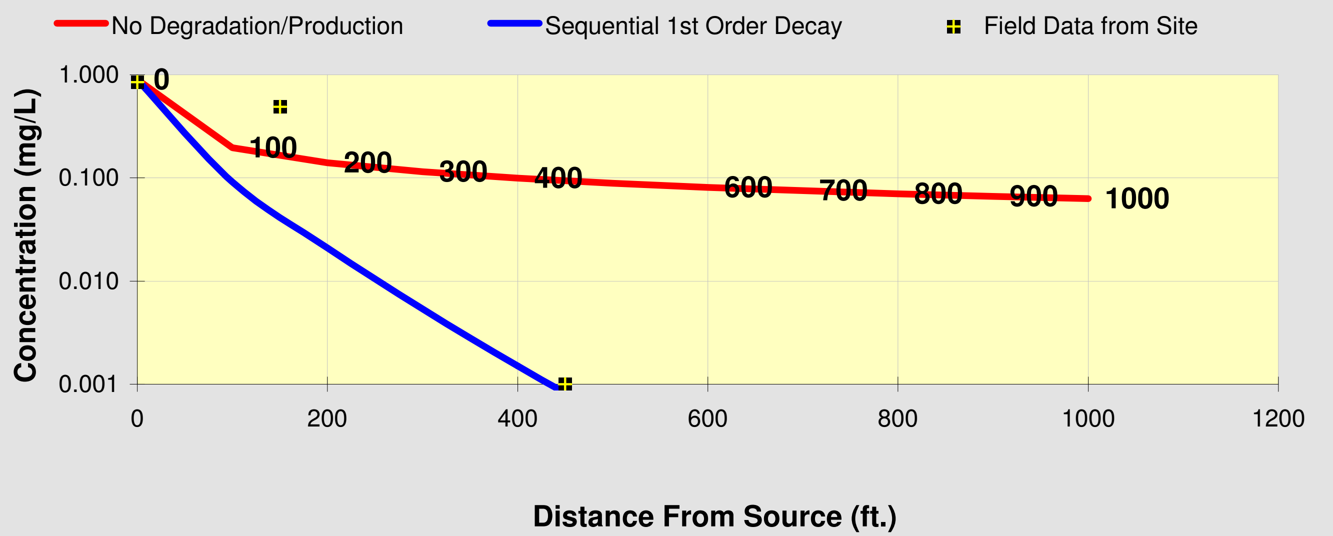
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	0.900	0.197	0.140	0.115	0.099	0.089	0.081	0.075	0.070	0.066	0.063
Biotransformation	0.9000	0.091	0.021	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0		150			450					
Field Data from Site	0.850		0.490			0.001					



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

30.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / *Distance from Source (ft)*	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.830	0.068	0.018	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000
-100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.2E+3	9.6E+2	2.6E+2	7.9E+1	2.6E+1	9.3E+0	3.3E+0	1.2E+0	4.5E-1	1.7E-1	6.3E-2

Show No Degradation

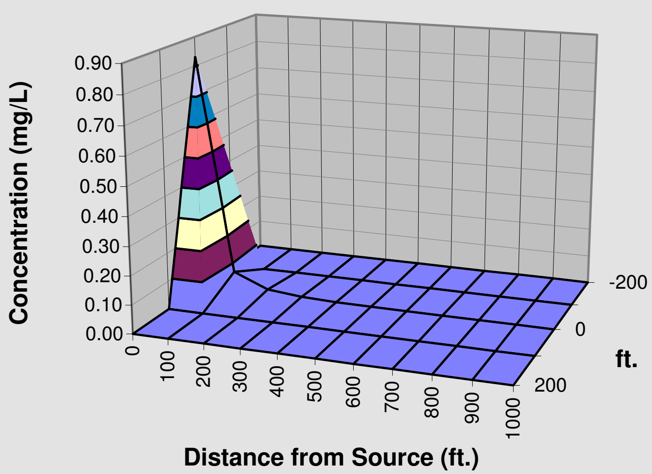
Show Biotransformation

Time: 30 yr

Target Level: **0.005** mg/L

Displayed Model: **Biotransformation**

Displayed Compound: **TCE**



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	3.5	*(Kg)*
- Plume Mass If Biotransformation/Production	1.2	*(Kg)*
Mass Removed	2.3	*(Kg)*
% Biotransformed =	**+64.6%**	
% Change in Mass Rate =	**100.0 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	1.35	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Plot All Data | Plot Data > Target | **Mass HELP** | **To Centerline** | **Return to Input**

Start Here → PCE TCE DCE VC ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / ***Distance from Source (ft)***

	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	2.000	0.110	0.022	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000
-100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	2.8E+3	1.6E+3	3.1E+2	8.2E+1	2.5E+1	8.2E+0	2.9E+0	1.0E+0	3.9E-1	1.4E-1	5.3E-2

Show No Degradation

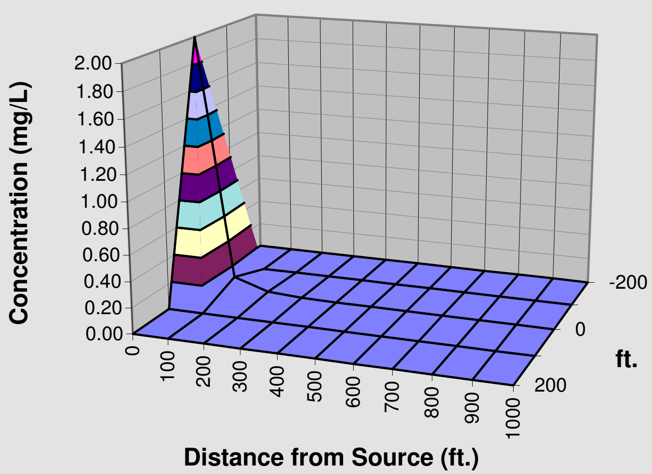
Show Biotransformation

Time: 30 yr

Target Level: **0.070** mg/L

Displayed Model: **Biotransformation**

Displayed Compound: **DCE**



Plot All Data | Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	8.5	*(Kg)*
- Plume Mass If Biotransformation/Production	2.8	*(Kg)*
Mass Removed	5.7	*(Kg)*
% Biotransformed =	**+67.1%**	
% Change in Mass Rate =	**100.0 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	1.35	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP | **To Centerline** | **Return to Input**

Start Here → ○ PCE ○ TCE ○ DCE ◉ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / *Distance from Source (ft)*

	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.900	0.091	0.021	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.3E+3	1.3E+3	3.0E+2	7.6E+1	2.2E+1	7.1E+0	2.4E+0	8.6E-1	3.1E-1	1.2E-1	4.3E-2

Show No Degradation

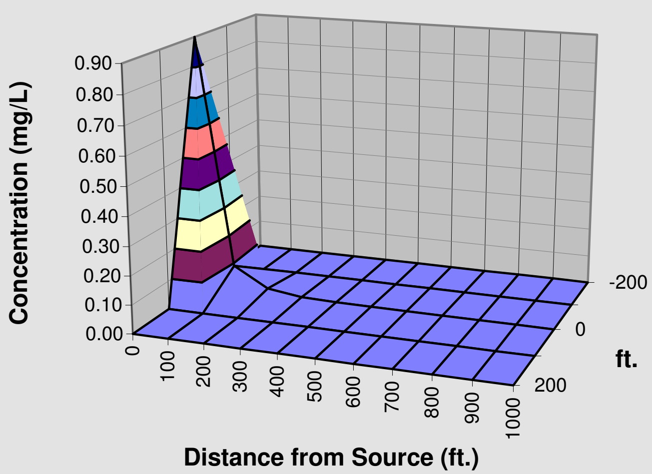
Show Biotransformation

Time: 30 yr

Target Level: **0.002** mg/L

Displayed Model: **Biotransformation**

Displayed Compound: **VC**



Plot All Data | Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	3.8	*(Kg)*
- Plume Mass If Biotransformation/Production	1.4	*(Kg)*
Mass Removed	2.4	*(Kg)*

If "Can't Calc.", make model area longer

% Biotransformed = **+63.5%**

% Change in Mass Rate = **100.0 %** (source to edge)

See acre-ft

Current Volume of Ground Water in Plume	1.35	*MGal*
Flow Rate of Water Through Source Area	0.000	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP | **To Centerline** | **Return to Input**

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

Run Name
OMC Plant 2
Source Zone 5

Data Input Instructions:

115 → 1. Enter value directly....or
or 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	24.3	(ft/yr)
or			
Hydraulic Conductivity	K	5.4E-03	(cm/sec)
Hydraulic Gradient	i	0.0013	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	24.9	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.45	(kg/L)		
FractionOrganicCarbon, foc	9.7E-4	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	1.73	(-)
TCE	166	(L/kg)	1.78	(-)
DCE	36	(L/kg)	1.17	(-)
VC	19	(L/kg)	1.09	(-)
ETH	302	(L/kg)	2.42	(-)

Common R (used in model)* = 1.73

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1

	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.231	3.00	0.79
TCE → DCE	0.990	0.70	0.74
DCE → VC	0.693	1.00	0.64
VC → ETH	11.550	0.06	0.45

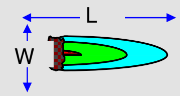
Zone 2

	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	100	(yr)
Modeled Area Width*	500	(ft)
Modeled Area Length*	1000	(ft)
Zone 1 Length*	1000	(ft)
Zone 2 Length*	0	(ft)



Zone 2= L - Zone 1

6. SOURCE DATA

TYPE: Continuous Single Planar

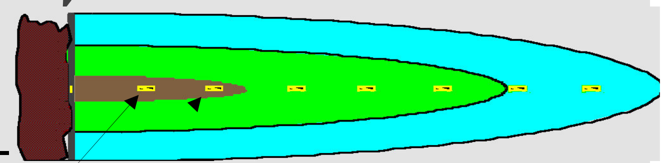
Source Options

Source Thickness in Sat. Zone* 15 (ft)

	Y1
Width* (ft)	300

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE		0
TCE	44.0	0
DCE		0
VC		0
ETH		0

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)											
TCE Conc. (mg/L)	44.0	23.0	1.1		.0			.001			
DCE Conc. (mg/L)		9.3	8.5		.001			.001			
VC Conc. (mg/L)		.2	3.1		.0			.0			
ETH Conc. (mg/L)											
Distance from Source (ft)	0	100	200		400			700			
Date Data Collected	2007										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | **RUN ARRAY** | ***Help*** | Restore Formulas | RESET | ***SEE OUTPUT*** | Paste Example

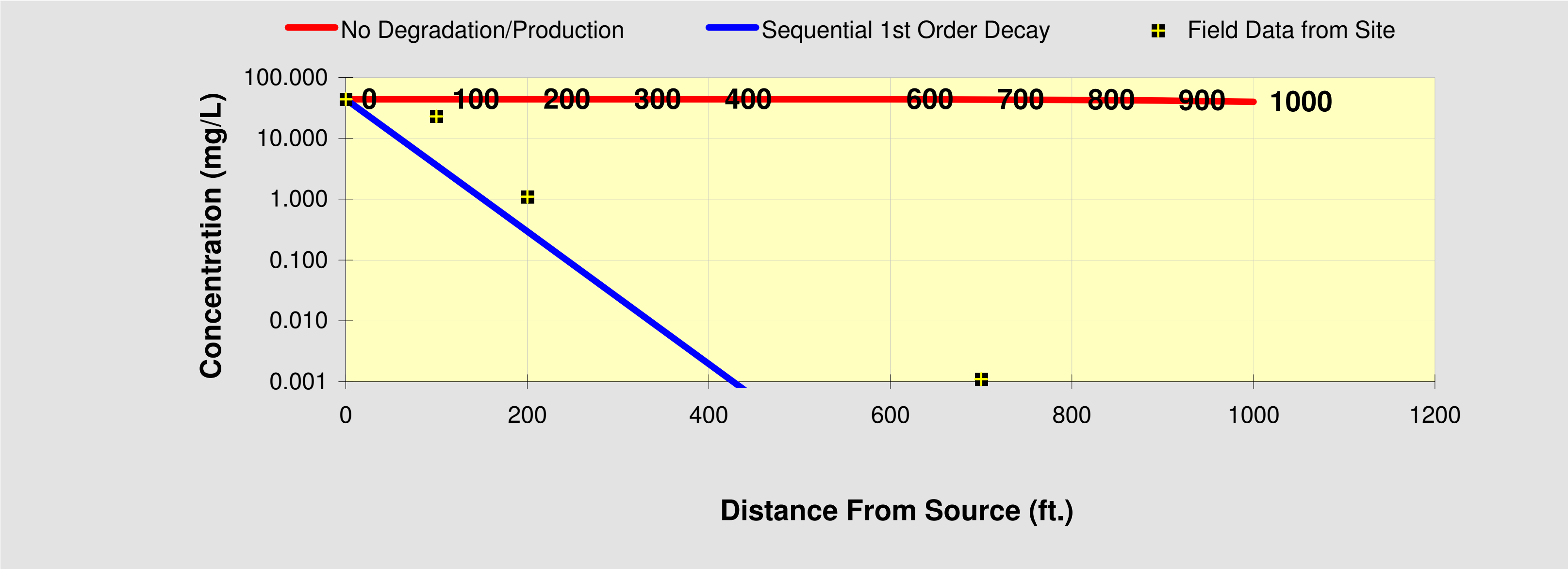
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	44.000	44.000	44.000	43.995	43.965	43.877	43.705	43.411	42.985	41.733	39.933
Biotransformation	44.0000	3.595	0.294	0.024	0.002	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	100	200		400			700			
Field Data from Site	44.000	23.000	1.100		0.000			0.001			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

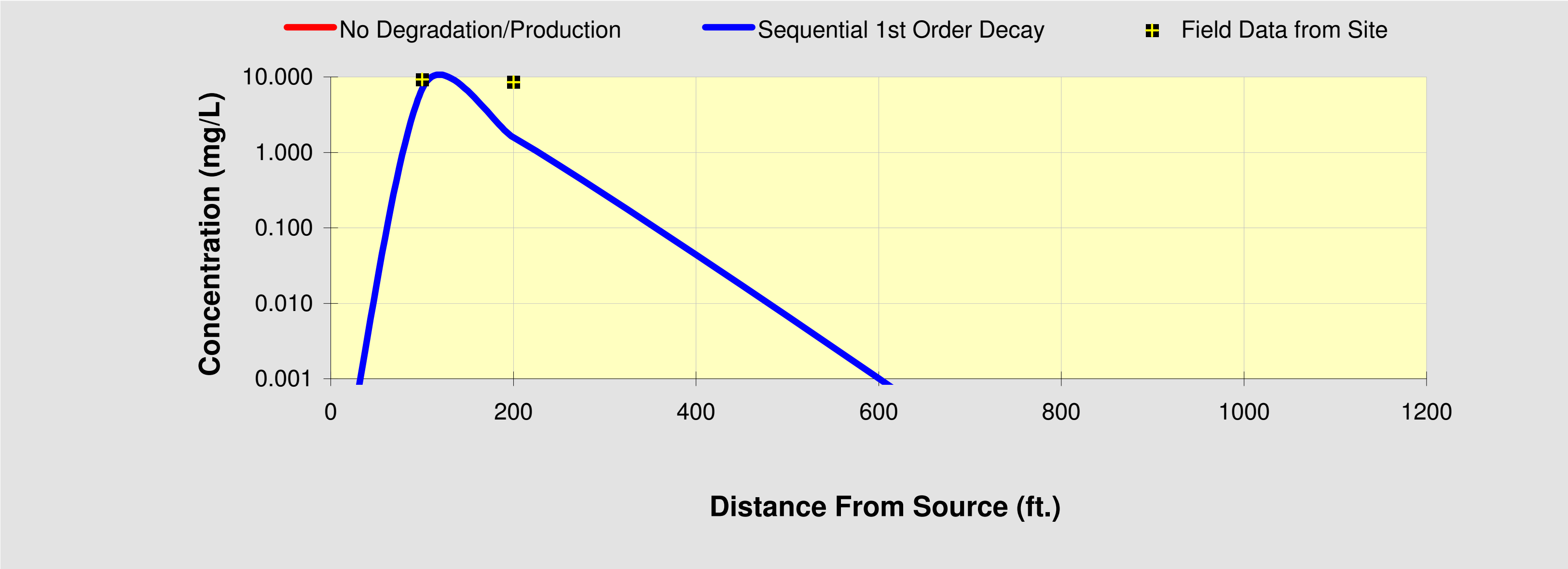
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	6.949	1.582	0.277	0.044	0.007	0.001	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	100	200		400			700			
Field Data from Site		9.300	8.500		0.001			0.001			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

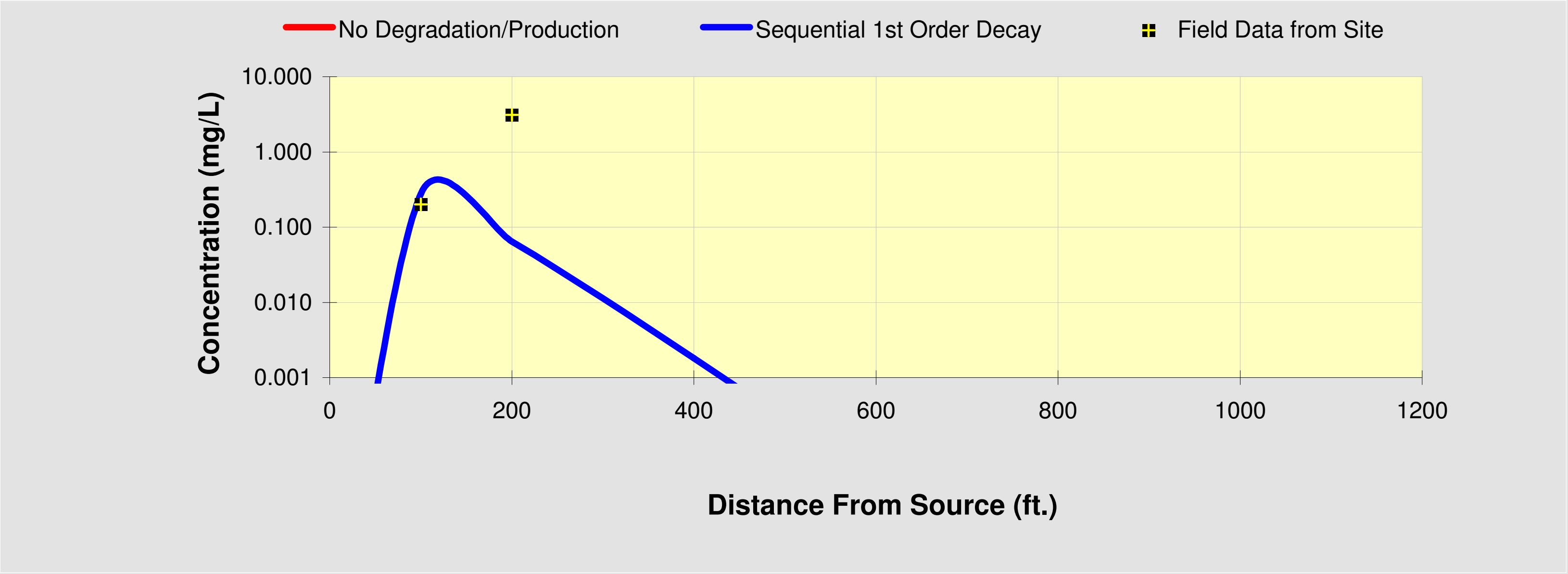
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	100	200	300	400	500	600	700	800	900	1000
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.276	0.064	0.011	0.002	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	0	100	200		400			700			
Field Data from Site		0.200	3.100		0.000			0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

100.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

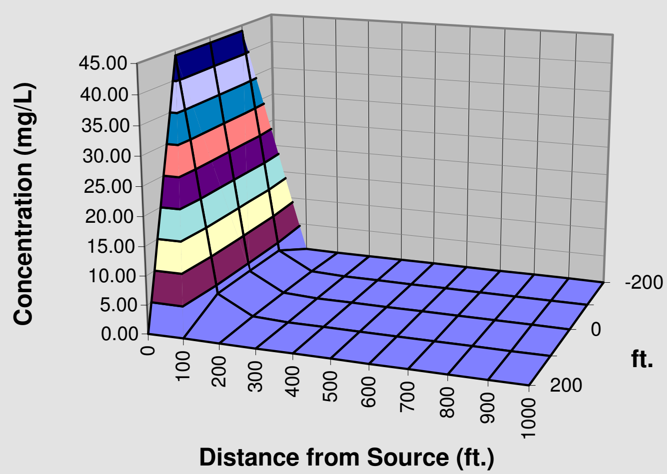
DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / ***Distance from Source (ft)***

	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.045	0.017	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	44.000	3.550	0.277	0.022	0.002	0.000	0.000	0.000	0.000	0.000	0.000
0	44.000	3.595	0.294	0.024	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-100	44.000	3.550	0.277	0.022	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.045	0.017	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.1E+5	9.2E+3	7.5E+2	6.1E+1	5.0E+0	4.1E-1	3.3E-2	2.7E-3	2.2E-4	1.8E-5	1.5E-6

Show No Degradation | **Show Biotransformation**

Time: 100 yr | Target Level: **0.005** mg/L | Displayed Model: **Biotransformation** | Displayed Compound: **TCE**



Plot All Data | Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	3010.5	*(Kg)*
- Plume Mass If Biotransformation/Production	171.0	*(Kg)*
Mass Removed	2839.5	*(Kg)*
% Biotransformed =	**+94.3%**	
% Change in Mass Rate =	**100.0 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	5.39	*MGal*
Flow Rate of Water Through Source Area	0.001	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP | **To Centerline** | **Return to Input**

Start Here → ○ PCE ○ TCE ◉ DCE ○ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

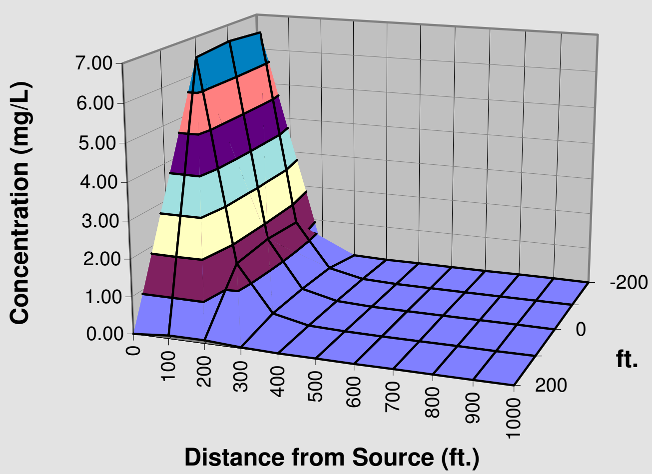
Transverse Distance (ft) / *Distance from Source (ft)*

	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.087	0.089	0.027	0.006	0.001	0.000	0.000	0.000	0.000	0.000
100	0.000	6.862	1.493	0.250	0.038	0.006	0.001	0.000	0.000	0.000	0.000
0	0.000	6.949	1.582	0.277	0.044	0.007	0.001	0.000	0.000	0.000	0.000
-100	0.000	6.862	1.493	0.250	0.038	0.006	0.001	0.000	0.000	0.000	0.000
-200	0.000	0.087	0.089	0.027	0.006	0.001	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.6E-2	1.8E+4	4.0E+3	7.1E+2	1.1E+2	1.7E+1	2.6E+0	3.8E-1	5.6E-2	8.2E-3	1.2E-3

Show No Degradation

Show Biotransformation

Time: 100 yr   Target Level: **0.070** mg/L   Displayed Model: **Biotransformation**   Displayed Compound: **DCE**



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	0.0	*(Kg)*
- Plume Mass If Biotransformation/Production	58.5	*(Kg)*
Mass Removed	-58.5	*(Kg)*
% Biotransformed =		
% Change in Mass Rate =	**92.5 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	7.74	*MGal*
Flow Rate of Water Through Source Area	0.001	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Plot All Data   Plot Data > Target   **Mass HELP**   **To Centerline**   **Return to Input**

Start Here →

○	PCE
○	TCE
○	DCE
◉	VC
○	ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

Transverse Distance (ft) / *Distance from Source (ft)*

	0	100	200	300	400	500	600	700	800	900	1000
200	0.000	0.003	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.272	0.061	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000
0	0.000	0.276	0.064	0.011	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-100	0.000	0.272	0.061	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000
-200	0.000	0.003	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	3.6E-4	7.0E+2	1.6E+2	2.9E+1	4.6E+0	7.1E-1	1.1E-1	1.6E-2	2.3E-3	3.4E-4	4.9E-5

Show No Degradation

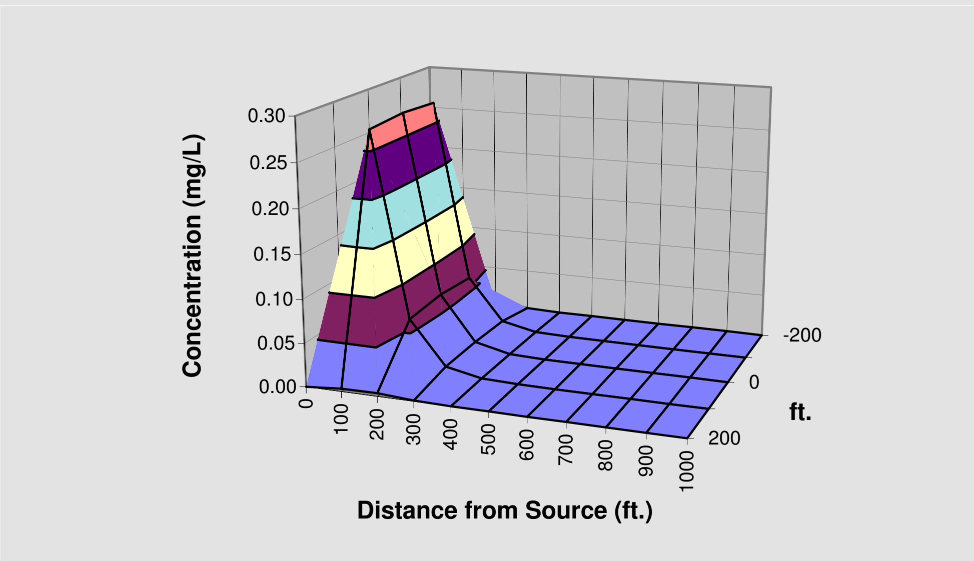
Show Biotransformation

Time: 100 yr

Target Level: **0.002** mg/L

Displayed Model: **Biotransformation**

Displayed Compound: **VC**



Plot All Data

Plot Data > Target

Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	0.0	*(Kg)*
- Plume Mass If Biotransformation/Production	2.3	*(Kg)*
Mass Removed	-2.3	*(Kg)*
% Biotransformed =		
% Change in Mass Rate =	**86.3 %**	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	3.03	*MGal*
Flow Rate of Water Through Source Area	0.001	*MGD*

Compare to Pump and Treat

Pumping Rate		*(gpm)*
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		*(yr)*

Mass HELP

To Centerline

Return to Input